NATURE

Vol. 147 SATURDAY, JUNE 7, 1941 No. 3736

CONTENTS

PAGE

Economic Policy To-day and To-morrow 687

Stars and Atoms. By Prof. J. A. Crowther 689

Research on Motor-Car Engines 691

Agricultural Production in Uganda. By J. H. Holland 691

Essentials of Interviewing 693

A Bird Observer in Cornwall. By Seton Gordon, C.B.E. 694

Plankton as a Source of Food. By Prof. A. C. Hardy, F.R.S. 695

Nature of the Intramolecular Fold in Alpha-Keratin and Alpha-Myosin. By Dr. W. T. Astbury, F.R.S., and Dr. Florence O. Bell 696

The Civilian Population Under Bombardment. By R. J. Bartlett 700

Obituaries:

Dr. Otto Pettersson. By Sir D'Arcy W. Thompson, C.B., F.R.S. 701

Mr. Francis Druce. By A. J. Wilmott 702

Dr. C. G. Lamb. By A. R. C. 702

Mrs. Beatrice Bateson 703

News and Views 704

Letters to the Editors:

Further Correlation of Physical and Biological Properties in an Acridine Series.—Dr. Adrien Albert, Reginald Goldacre, and Dr. Sydney D. Rubbo 709

'Crossed Fibrillar' Structure of Plant Cell Walls.—Dr. R. D. Preston 710

Chemical Substitutes for Dietary Protein.—E. C. Owen, J. A. B. Smith, and Dr. N. C. Wright 710

"Vegetables as Food".—V. H. Booth, L. W. Mapson, and Dr. T. Moore; Miss Mamie Olliver and W. B. Adam 711

Effect of Flow on the Dielectric Constant of Liquids.—Prof. S. P. Prasad, B. N. Singh, and B. D. Singh 712

Kinetic Friction Coefficient.—Prof. Sidney Russ, C.B.E. 712

Research Items 713

Deficiency of White Flour in Riboflavin (Tested with the Flour Beetle *Tribolium confusum*). By Dr. G. Fraenkel and M. Blewett 716

Fatigue Following Highly Skilled Work. By Prof. F. C. Bartlett, F.R.S. 717

Role of Radiation Mutations in Mankind. By Dr. H. J. Muller 718

Skin Effect in Composite and Ferro-Magnetic Wires 719

Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rate is £3 0 0, payable in advance, Inland or Abroad

Advertisements should be addressed to: T. G. Scott & Son, Ltd., Three Gables, London Road, Merstham, Surrey - - - Telephone Number: Merstham 316

Registered as a Newspaper at the General Post Office All rights reserved

THE IDENTIFICATION OF MOLECULAR SPECTRA

By R. W. B. PEARSE, D.Sc., F.R.A.S.
Lecturer in Physics, Imperial College of Science and Technology

and A. G. GAYDON, Ph.D., A.Inst.P.
Leverhulme Research Fellow, Imperial College of Science and Technology

The purpose of these tables is to facilitate the identification of molecular spectra. Several books have been written on the theory of molecular spectra and a few have included a collection of the values of molecular constants derived from the spectra, but in order to identify an unknown band spectrum it has hitherto remained necessary to search through original papers or to calculate the positions of bands from the constants tabulated. Thus the task is usually tedious and sometimes impossible to one without considerable experience.

The authors have collected in this volume such information about the appearance and occurrence of each known band spectrum as may assist in its identification. Though the data given are often useful for other purposes, in their presentation the object of identification has been kept foremost throughout. It is hoped that this work will prove of service not only to pure spectroscopists, but also to those who use spectroscopy as a tool for research in other fields such as astrophysics, chemistry and chemical technology. The spectra dealt with include, besides those of diatomic molecules, the more readily observed of the spectra of triatomic and polyatomic molecules.

Imperial 8vo. 229 pages, 8 full page half-tone plates. 42s. net.

CHAPMAN & HALL, LTD., 11 HENRIETTA STREET, LONDON, W.C.2

Bausch & Lomb
COLORIMETERS
are designed to meet the most exacting requirements

SPECIAL FEATURES OF IMPORTANCE ARE

Extra large eyepiece aperture which simplifies colour matching.

Dustproof prism system.

Optically inactive tube bottoms and plungers matched for colour.

Further information on request.

Bausch & Lomb Optical Co. Ltd.
Africa House
KINGSWAY LONDON, W.C.2

B-S
Standard Refractometer

A Polarising Eyepiece *for the examination of doubly refracting fatty materials can be provided, and also an* **Electric Lamp Attachment** *for back illumination of dark or opaque materials.*

BELLINGHAM & STANLEY LTD.
71 Hornsey Rise, London, N.19
Phone: ARChway 2270

Editorial & Publishing Offices :
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address :
PHUSIS, LESQUARE, LONDON

Telephone Number :
WHITEHALL 8831

Vol. 147 SATURDAY, JUNE 7, 1941 No. 3736

ECONOMIC POLICY TO-DAY AND TO-MORROW

RECENT debates in the House of Commons, notably on the War Damage Bill, have amply vindicated the value of our democratic institutions in sustaining and guiding the national effort. Without questioning its confidence in the present Government, the House of Commons shows no signs of abdicating its associated practice of vigilant supervision and the voicing of public opinion ; and by its co-operation with the Government as a kind of Council of State, while maintaining its vigilant watch over policy and achievement, its sensitive interpretation of public opinion and constructive but searching criticism of administration has gone far to rehabilitate the prestige of Parliament and silence criticism which was rampant in the years immediately before the War. Mr. Pethick-Lawrence claimed with justice that in the War Damage Act debates we see democracy at its best, and Sir Percy Harris added that "the Chancellor has justified, in war-time, the working of the democratic machine. The House of Commons has been for this Bill, a Council of State." Much the same could have been said of the recent debate on the War, when keen criticism was focused on those questions of production and man-power which have so far restricted severely our policy and our strategy.

Nor is the House of Commons alone in exercising such functions. It is reinforced by its own Select Committee on National Expenditure, the reports of which, inspired by a wide view of its functions, have been models of the type of searching scrutiny and constructive proposals demanded, and have admirably supplemented the work of the House of Commons. Other bodies also are maintaining a watchful attitude. Among them is the Vigilance-for-Victory Group, composed primarily of politicians, prominent newspaper men and publicists who can report accurately upon public opinion and give it expression, and experts of trade and the professions affected by the problems which the Group examines. Its bulletins are complementary to the admirable contributions which the broadsheets issued by Political and Economic Planning (P E P) have already made to the national effort, and they supply an example of the type of contribution which scientific workers themselves may be expected to make in their own particular fields.

Informed, searching and constructive criticism is one of the first duties of the scientific worker ; there should be no excuse for slackness in this field either through failure to use effectively the machinery already established, from the Scientific Advisory Committee downwards, or to create new machinery if that already in existence is inadequate. They have, as it were, to play the same part as the Observer Corps to the Fighter Command, watching each situation as it develops in fields that are their special concern, and as quickly mobilizing expert opinion to consider and recommend effective and urgent measures to the authorities.

This is the view of its own functions taken by the Vigilance-for-Victory Group and is reflected in its fourth bulletin, which deals with the new plans of the Minister of Labour and National Service. The bulletin agrees with Mr. Bevin that compulsion should be avoided wherever possible on account of its effect on morale, but considers that more could have been done to reduce the need for compulsion by the comprehensive organization of all productive resources, especially of the distributive trades, which are probably the largest untapped source of man-power ; by a rational wages policy designed to facilitate the transfer of workers from non-essential to essential work ; and by a training scheme more attractive and extensive than that now in force. The measures now

announced, it is considered, will not yield an adequate turnover of labour unless accompanied by an undesirable amount of compulsion. To be effective they must be supplemented by economic and financial planning of the kind which the Government has been reluctant to undertake.

Recent changes in the Government may indicate a belated move in this direction. The new appointment of Lord Beaverbrook as a Minister of State free from departmental duties may betoken recognition of the value of Cabinet Ministers capable of detached views and of co-ordinating policy, while the merging of the Ministries of Transport and Shipping is obviously intended to facilitate co-ordination. They are, however, only a short step towards the measures which the Vigilance-for-Victory Group believes are necessary.

In the sphere of industrial reorganization, the first need is to establish a pooled and controlled industrial machine, so as to increase productivity and facilitate the transfer of labour. The machinery for distributing orders for military and other supplies must then be reformed on a unified basis, and in the distribution of orders between localities the question of adequate labour supply must be one of the most important considerations. This latter point is also strongly made by Mr. G. D. H. Cole in an article on man-power in the *Political Quarterly* of April–June; Mr. Cole suggests that the regional shortage of workers is likely to be the principal difficulty in the way of expanding the output of munitions during the next twelve months.

This question is linked up with man-power policy, where the evolution of a national wage policy is the first essential. This depends on a rational consumption and price policy, that is, rationing, and on the establishment of a central wages tribunal. Revision of the wage structure is the next essential, including overtime for night shifts, so that it stimulates the transfer of labour where it is required. As a revision of relative wages must take place by an upward revision of the wages paid for occupations where man-power is needed, this depends, if inflation is to be avoided, on a strict rationing of goods. To improve the unsatisfactory position of training, the Vigilance-for-Victory bulletin, like Mr. Cole, recommends that training be paid as a job. Moreover, to prevent injustice or profiteering, billeting should be compulsory on the householder and all extra costs resulting from the transfer of labour borne by the State; stress is also laid upon finding a logical plan of compensation in place of the present system of allowances for members of the Fighting Forces.

Regional committees of production experts, with power to enforce their advice as to training, direction and use of skilled workers should be established, without interference from the Supply Departments, and appropriate social services should be introduced where necessary to increase the supply of man-power. These measures would go far to achieve the necessary transfer of labour by voluntary action. Certain measures enabling the Government to use compulsion, however, should also be enacted. The prohibition against leaving employment without permission should be replaced by a general prohibition of hiring without permission, and people not at the moment employed in industry should be required, by registration, to show reason why they are not in employment. If they do not fall into certain well-defined exempted categories, they should be asked to undertake suitable work. Modification of the unemployment insurance and assistance schemes for the duration of the War, securing to all displaced labour its previous wage and subsistence and separation allowances, provided it accepts training or suitable jobs, accompanied by a stringent and fair distribution of available supplies and goods by compulsory mobilization of property, and a fair system of taxation, would limit direct compulsion primarily to compelling *entrepreneurs* to reorganize production on a war-time basis. Reorganization on the supply side would minimize the necessity for migration, which is now causing most of the friction, discontent and bottlenecks.

These conclusions and recommendations are strikingly in harmony with the main points made by Mr. Cole, who considers that the problems arising out of migration—billeting, difficulties of transport and allowances and irrational differences in wages and earnings between one district and another—are the most serious obstacle to the full utilization of the available man-power of Great Britain. The second principal obstacle is the continuance, despite Government control, of each privately owned business as a separate unit, with which the Government departments enter into separate contracts. He considers that man-power could be much more effectively applied if the Government took over completely all the important munition-making firms, and pooled their resources in each locality under unified local management—in any event to the extent of grouping all firms engaged in closely related types of

work. This step, by assisting transference, would help immensely to solve the other problems of labour migration.

Industrial mobilization is now proceeding on definite lines whether or not the pace can yet be regarded as satisfactory. The notion of a total war economy using all available reserves, specialized or otherwise, is gaining ground and the principle of complete concentration of those industries which are being contracted because they do not contribute directly to the war effort or to the maintenance of civil life has been unhesitatingly accepted. If, however, it is to be worked out adequately, it may be necessary for the Board of Trade to accept greater responsibility for directing industry towards the agreed ends. Certainly it cannot be achieved unless the policy of concentration and distribution of man-power is guided by a scientific and carefully worked-out plan.

Mr. Lyttelton in recent speeches has indeed hown an encouraging grasp of the essentials of war economics, and his statement of the Government's economic objectives in the War shows that it has already begun to think about post-war economic policy. These objectives he put under five heads: the mobilization of plant, raw materials, shipping, etc., for war production; secondly, the rationing of the civil population so that only essentials are made; thirdly, the mobilization of man-power; fourthly, the avoidance of inflation and the cheap finance of the war; and fifthly, the starting of the creation of post-war plans. Mr. Lyttelton already has a special section charged with examining particularly the problems of the first two or three years after the War.

Once again, then, we find that the war effort is linked up with post-war plans, and on this aspect Mr. Lyttelton makes two points. Internationally, we shall be a debtor nation and may require to continue a selective export policy and to control imports. We shall also have to prevent an unregulated replacement boom. Government control of industry can therefore only slowly be released, and must continue for some time after the War. The economic peace must rest on domestic and international regulation and co-operation. These points were elaborated in the speech made by Mr. Anthony Eden, on May 29, when he pointed out, among other matters, that the British Empire and Allies with the United States and South America will alone be able to undertake the reconstruction of Europe, and that "it will be our wish to work with others to prevent the starvation of the post-armistice period, the currency disorders and the wide fluctuations of employment, markets and prices" which followed the War of 1914–18.

Whatever may be thought of the adequacy of particular solutions, we are moving far from the assumptions on which our pre-war discussions of trade and the control of industry were based. We must be prepared for and endeavour to create a new technique in economic government. Mr. Lyttelton's emphatic vindication of the Government's economic policy as inspired by a comprehensive plan embracing the whole problem and clearly relating each part to every other should induce scientific workers to see that the framework of scientific co-operation and organization is adequate both to the demands of war-time and to the reconstruction to follow.

STARS AND ATOMS

The Birth and Death of the Sun

Stellar Evolution and Subatomic Energy. By Prof. George Gamow. Pp. xv+238+16 plates. (London: Macmillan and Co., Ltd., 1941.) 12*s*. 6*d*. net.

The World and the Atom

By C. Møller and Ebbe Rasmussen. Translated from the second Danish edition by Gerald C. Wheeler and Bernard Miall. Pp. 200. (London: George Allen and Unwin, Ltd., 1940.) 10*s*. 6*d*. net.

IT is often alleged that men of science are culpably indifferent to the cultural and intellectual needs of the society in which they live and work. The tremendous uprush of scientific discovery during the last fifty years, an uprush which as yet shows no signs of abating, has raised social and intellectual problems which make it imperative that the man in the street should acquire some appreciation of scientific method and the results of its application, if only that he may be able to distinguish the true prophet from the charlatan. It has even been suggested by a recent correspondent to NATURE that the education of the public in general, and of the leaders of public opinion in particular, may be the most

valuable service which scientific workers can render the community.

If the charge of culpable negligence in the discharge of this duty was ever fairly levelled against men of science as a whole, which I must not stay to argue, a number of books have appeared within the last year or so of a quality and attractiveness which must at any rate secure an acquittal for the physicist. It is not very long since Gamow's "Mr. Tompkins in Wonderland" told the general reader all that he is likely to know of quantum theory and relativity; and wise folks who procured a copy of George Russell Harrison's "Atoms in Action" (see NATURE, December 14, 1940, p. 760) will have enjoyed an authoritative and admirable picture of the state of applied physics. The reader who, with appetite increased by what it fed on, asks for more, can be recommended to the books listed at the head of this notice, which deal with still other aspects of modern physics.

Gamow deals with some of the major problems of astronomy: Møller and Rasmussen with the riddle of the atom and its nucleus; the one with the infinitely large, the others with the infinitely small; but it is extraordinary how much ground the two books have in common. This is more than a coincidence. It is an illustration, and a very good one, of the essential unity of all research. A successful attack on one obscure part of the subject may lead to a sweeping advance all along the line; and the work of the 'atom-smasher' in the darkened laboratory has enabled the astrophysicist to write a new chapter in the history of the universe. The moral of this may be left for participants in the "Science and Politics" correspondence to draw.

Astronomy has always had its devotees. The mysteries of the heavens have always excited the wonder of mankind, and wonder is the legitimate parent of research. The question as to how the sun came into being, whence it draws its enormous supply of energy, and what is to be its ultimate fate must excite speculation and interest. Its solution, involving, as it does, the application of the principles of physics to conditions of temperature and pressure far exceeding anything available in terrestrial laboratories, demands the exercise of controlled imagination of the highest order. Some chapters of the story have already been written by Eddington and Jeans. Recent work on the transmutation of the elements begun by Lord Rutherford and now being extended by a host of physicists has added a new chapter to the tale. In brief, the extremely high-tension apparatus designed for 'atom-smashing' is able to give to a few particles a degree of energy of the same order of magnitude as that which they habitually possess in the interior of the sun. By hurling these high-speed particles at atoms of various kinds it is possible to study, on a very microscopic scale, reactions which must be going on, on an enormous scale, in the sun's interior. It is well known that energy on a large scale is set free in some of these reactions, and mankind has begun to look wistfully, but not very hopefully, to the day when it may be able to draw on this sub-atomic energy. It now turns out that our sun and its fellows have been tapping this great reservoir for ages.

It is an exciting story, and Prof. Gamow tells it extremely well. He has two great qualifications for the task. In the first place he has been closely connected with the work described, and gives to it all the vividness of an eye-witness's narrative. Secondly, he so obviously enjoys the story himself. The pursuit of a new physical problem clearly gives him all the fun and excitement of the chase, an excitement which he communicates to his readers. Prof. Gamow has a real flair for making difficult ideas appear simple, and an engaging sense of humour which not only breaks out in the text, but also illuminates the pictures and diagrams with which he has himself illustrated the book.

"The World and the Atom", by Møller and Rasmussen, is a scholarly account of the rise and progress of atomic physics from its inception at the beginning of the century to about 1938. The authors, one a theoretical the other an experimental physicist, are members of the Institute in Copenhagen presided over by Prof. Niels Bohr, who contributes a foreword. The book is a clear and well-balanced history of one of the great formative periods in science. The gradual introduction of new and ever-broadening conceptions into the structure of physics is clearly traced; and the essential parts played by the experimental physicist, the mathematician, and the technologist, and their reactions upon each other, are ably demonstrated.

In standard the book seems to lie somewhere between the entirely 'popular' and the elementary text-book. A student of modern physics would find it of value in co-ordinating his ideas, while the serious layman, wishing to gain an intelligent appreciation of one of the outstanding achievements of our age, should not find it beyond his powers. The book suffers a little from a certain heaviness in style which seems almost inevitable in a translation, but there is no lack of clarity.

Both books are excellently produced, and illustrated with diagrams and plates. Some of the Mount Wilson photographs of celestial phenomena reproduced in "The Birth and Death of the Sun" are a sheer delight.

J. A. CROWTHER.

RESEARCH ON MOTOR-CAR ENGINES

Collected Researches on Cylinder Wear

By C. G. Williams. Pp. vii+119. (London: Institution of Automobile Engineers, 1940.) 10*s.* 6*d.*

THE work being carried on at the research station of the Institution of Automobile Engineers at the Great West Road, Brentford, which was outlined in a description of the Laboratory in NATURE of November 23, 1940, is exemplified in the publication of "Collected Researches on Cylinder Wear", by C. G. Williams.

It is pointed out in the late Lord Austin's foreword that the problem of cylinder wear is one of the most serious with which motor-car manufacturers have had to deal. Individually, they have done much useful work towards its solution in their own laboratories, but owing to its complexity it was thought best to have it dealt with comprehensively by the Institution, and the several reports which constitute this publication confirm the advantage of this arrangement, not only in unifying the direction of the investigations but also in bringing together and releasing for general use the full range of information collected.

These collected researches include four interim reports on experiments carried out at the Institution's Laboratory, a discussion of published information on the subject, the collected experiences of manufacturers and operators giving the accumulated data prior to the adoption of the work at the new laboratory, a later report of more recent experiences and the results of an investigation of cylinder liner materials.

It had been suspected for some time that it was during the initial warming-up period that wear mainly takes place, but this partial knowledge led to an accentuation of the trouble as, in ignorance of the main source of wear, a wrong procedure was adopted. The contributory causes are many and various, associated as they are with mechanical and frictional conditions, the properties and chemical reactions of fuel and exhaust gases, high temperature, composition and structure of the metals in contact, influence of lubricating oils and so on. It is proved, however, that corrosion, not abrasion, is the main cause of cylinder wear, and there are several sources from which it may arise. Besides the action of water, which, as shown, can cause corrosion through oil films, there is the certainty of acidic conditions being produced from organic acids, sulphuric, nitric and carbonic acids derived in small proportions from the normal components of the fuel. The investigation of these miniature chemical processes will be found one of the most interesting phases of this series of researches, dealing as they do with many other complex and almost infinitesimal actions and reactions.

These researches were carried out with the view of making immediate use of the knowledge gained in the improvement of engines, and the report dealing with the more recent experiences of manufacturers and operators bears out their value. One improvement of major importance is the use of more suitable cylinder materials; special reference is made to nitrogen-hardened cast iron with its resistance to abrasive wear, and to austenitic cast iron, which can withstand both corrosive and abrasive wear. On many other points, this section gives details of the practical results which have accrued from the work of the Laboratory.

AGRICULTURAL PRODUCTION IN UGANDA

Agriculture in Uganda

By the Staff of the Department of Agriculture, Uganda. Edited by Dr. J. D. Tothill. (Published by authority of the Government of the Uganda Protectorate.) Pp. xvi+552+30 plates. (London: Oxford University Press, 1940.) 20*s.* net.

THIS is a comprehensive volume of information contributed by the staff of the Department of Agriculture in Uganda on agricultural conditions—including native agriculture, land tenure, soils, manures—imported, artificial, green and cover crops; climate, crops and allied subjects. The important associative sciences of mycology and entomology are also dealt with very thoroughly, the fungus and insect pests being discussed at length under each crop, though bees and locusts are treated in a separate section.

Under "Native Agriculture: Development of Ox-Cultivation", it is recorded that chiefs in Budama were first instructed in the use of the plough in 1909 and a ploughing school was started in 1910 at Kumi (in Teso). The first ploughs used in Teso were wooden, made locally from an Indian pattern; but, these, it is stated, were soon dis-

carded in favour of European iron ploughs. Various types of these appear to have been tried, and the one most in favour at the present time is Ransome's "E.C.A." Other implements, ox-cultivators, etc., have been tried, but they do not appear to have come into general use. The tillage operations after the plough are still done by hand, which, the author of this subject states, is "one of the limiting factors to increased acreage of cotton by means of the plough".

It is not possible within the limits of this notice even to enumerate all the plants grown; but a few details of the main items may be mentioned, the production of which is fully discussed under various headings, mainly: "Native Food Crops: Sweet Potatoes, Cassava and Yams; the Cereals—'Bulo' (*Eleusine*), Maize, Sorghum, Rice and Wheat; Ground Nuts, Simsim (seed of *Sesamum*) and the Pulses—Pigeon Peas, Cow Peas, Tepary, Soy and Haricot Beans."

Fruits and vegetables are given a special section covering pp. 485–495. The most important fruits of Uganda, it is stated, "have been introduced, many are cultivated by the Natives for their own consumption and for sale in the markets of the towns." The principal fruit is the banana, to which a whole chapter is devoted (pp. 111–125). Some particulars are given of citrus fruits, the mango, avocado pear, guava, pine-apple, papaw and passion fruits; the record concluding with an extensive list of miscellaneous fruits, tropical and temperate, introduced into Uganda.

Under "Vegetables"—indigenous pot-herbs, wild yams (*Dioscorea*), etc., introduced tropical—okra (*Hibiscus*), egg-plant (*Solanum*), peppers (*Capsicum*) and chayote (*Sechium*) are cultivated. Among temperate vegetables grown at higher altitudes it is interesting to note the potato (*Solanum tuberosum*), many varieties of which have been imported during the last twenty years, mostly from Kenya, and now grown for sale to Europeans and for local native markets. It thrives at elevations of about 6,000 ft.—notably in Bugishu and Kigezi, where the crop yields well and has become an important foodstuff. Tomatoes are extensively produced and onions, shallots, etc., are cultivated on native farms. Cabbages and cauliflower are common in Buganda where they are major market-garden crops. In general it would seem that most European vegetables can be grown at suitable altitudes.

These developments in the production of food-stuffs, especially fresh fruit and vegetables, are of great importance in view of the recent investigations into pellagra—a deficiency disease—carried out by the medical officers in tropical Africa.

The main crops grown on a plantation on a commercial scale are coffee—robusta and Arabian, cacao, para rubber, tea, sugar and tobacco. The fibre plants, cotton and sisal only appear to have reached export standard among other fibres introduced and under trial. The history and development of cotton is given in full under Section viii, pp. 183–288, the importation of varieties for trial beginning about 1903–1910, the industry developing until, as the author states, "Uganda now competes with the Sudan for second place among the cotton producing countries of the British Empire, with a crop lately exceeding 300,000 bales." Sisal—first introduced in 1903—was not grown in commercial plantations until 1929, when an estate was established at Masindi Port, whence in 1936, 1,500 tons were exported. Other fibres that are or have been under trial include Mauritius hemp, sunn hemp and ramie or China grass.

Oil yielding plants (Section xiv) include cotton seed—50,000 tons average for five years (1930–35) shipped from Mombasa. Oil palm (*Elaeis guineensis*), a native of West Africa, is also found wild in Uganda near the Congo border. The oil is not exported; but the cultivation is suggested for both pericarp and kernel oils as "a useful addition to native diet, which is poor in fats." Shea butter nut (*Butyrospermum parkii*) is found in the northern parts of Uganda, where the oil from the seeds is used for cooking; but neither nuts nor fat are exported. Tung oil (*Aleurites* spp.) native of China, and candle nut (*Aleurites moluccana*), native of Malaya, are under trial. Lemon grass (*Cymbopogon citratus*), introduced from Kew about 1901, is stated to be the only essential oil plant grown on a commercial scale in Uganda, and other essential oil plants that appear to be still under trial are geranium (*Pelargonium* spp.), patchouli (*Pogostemon* spp.) and vetiver (*Vetiveria zizanioides*). In 1929 a study of all the available essential oil plants was carried out by the botanical and chemical sections and the conclusion they came to was that: "at the present it is unlikely that the commercial production of essential oils will become important in Uganda."

Spices and drugs, native and introduced are discussed in Section xv., pp. 457–466: Of the native spices it is stated: "Few if any of the plants indigenous to Uganda have been used as a source of spice." The introduced plants, mostly under trial except where otherwise stated, are the well-known spices—peppers (chillies or red pepper—*Capsicum* spp.)—naturalized; cinnamon, cloves, turmeric, ginger—well established, but not grown as a commercial crop; and vanilla—cuttings introduced from Ceylon in 1912, now being produced on a commercial scale on a plantation at Entebbe. As to native drugs, there appears to be little information available and those introduced are all

more or less under trial: areca nut palm, cocaine plant, quinine bark, wormseed (*Chenopodium*) and *Hydnocarpus* spp.

Included in the same section (xv), tans, dyes, gums and resins are briefly dealt with in less than two pages. The bark of two native trees, *Acacia spirocarpa* and *Terminalia velutina*, is used locally for tanning; wattle bark (*Acacia decurrens* var. *mollis*)—native of Australia, is used by the natives as a wind-break, for building-poles and for fuel in Kigezi, where it has been planted in large quantities but owing, it is said, to high cost of transport, the bark is not exported. Specimen trees of "Tara" (*Caesalpinia spinosa*) and "Divi-divi" (*C. coriaria*)—pods are an important trade tanning material from the Colombian Andes—are under trial. Of dyes it is remarked: "Few native plants have been used to any extent for dyeing for there is no native cloth weaving or fine leather industry as in West Africa." Of gums and resins the author states: "Many native trees produce gums but the trade in such products has never been large." Specimens of various exotic gum and resin producing plants are growing at Entebbe including balata, gutta-percha, chicle gum and benzoin; "all grow quite well but none shows prospect of being commercially important in Uganda."

The final pages of the text treat respectively of "Cover-Crops and Shade Trees", "Fruits and Vegetables" (mentioned in this note under Foods), "Grasses and Grazing"—including "Weeds", "The Marketing of Native Produce" and "Agricultural Education and Extension Work". Excellent indexes to scientific names of plants, of insects and general, conclude the book.

Agriculture at the present time in practically all countries is of paramount importance, especially so in the tropics, whence come many of the raw materials—rubber, fibres, oils, etc.—to quote a few examples only, on which our great manufacturing centres depend. Sisal hemp for example, in its use for binder-twine for harvesting machinery, may mean in every yard of its manufacture the saving of a loaf of bread, and in production and use it probably ranks second to cotton, which is regarded as the world's greatest industrial fibre and the most important of all agricultural products in international trade. When the ruling powers come to take stock of the resources on an international scale after the present world's disturbance of trade and transport, such works as the one now under review, based on many years experience, will not be found wanting.

The authors are to be congratulated on producing a very useful and handy volume, more readily accessible than the official agricultural technical papers and bulletins in which, as stated by the editor in his introduction, "much of the information has been published", and as foreshadowed by him, calculated to "enable those who are interested in the present state of Agriculture in this part of Africa to obtain reliable data quickly".

J. H. HOLLAND.

ESSENTIALS OF INTERVIEWING

The Psychology of the Interview

By R. C. Oldfield. Pp. xv+144. (London: Methuen and Co., Ltd., 1941.) 5*s*. net.

IN recent years psychologists have come increasingly to realize that the proper conduct of an interview is one of their basic techniques, whether it is used for supplementing experiment or as itself the chief tool of inquiry. Some parts of Mr. Oldfield's brief study bear on the psychological nature of interviewing in general, but in spite of its comprehensive title the book is in the main limited to the interviewing of candidates for employment, in itself an important enough topic to justify the closest study.

Part of the book offers sensible practical suggestions as to the setting and conduct of interviews. They represent a pooling of the practice of several experienced interviewers whose methods Mr. Oldfield was allowed to observe. The current practice, however, is not merely recorded but is also assessed from the psychological point of view, and Mr. Oldfield writes with good insight into the social situation created by interviewing. The total picture he presents, familiar though its details are, will be found illuminating even by experienced interviewers.

But Mr. Oldfield's chief interest is clearly theoretical. He is concerned to give an exact psychological description of the processes in which interviewing consists. In the first place he argues convincingly that each interview must remain a unique social situation, manipulated and interpreted by the interviewer according to his personal skill and intuitive insight. That is to say, the interview must be an achievement of personal craftsmanship and cannot be turned into a standardized experimental situation in which the only variable is the candidate. This is probably true of the type of interview Mr. Oldfield is discussing, where conversation is relied on almost exclusively, but it may need to be slightly modified

if one considers interviews where the candidate's approach to standardized tasks, such as performance tests of intelligence, is systematically observed for the light it throws on temperamental qualities.

A useful theoretical contribution is the insistence that conversation, the texture of the interview, consists in a mutual modification or manipulation of attitudes, and that the exchange of information and specific opinions is only subsidiary, a means to the evocation of attitudes. This is in line with the growing recognition that the relative importance of cognitive experience and verbal behaviour has for long been exaggerated. Mr. Oldfield's view, however, is in danger of becoming too abstract to be useful when he reduces the interviewer's entire activity to the evocation and perception of attitudes in the candidate. This view of the matter cannot be said to be untrue, since all human activity expresses itself in a sequence of attitudes. But it ignores the important question of what feature of the candidate's personality a given attitude chiefly reflects; whether, for example, a broad temperamental quality or a particular sentiment. The importance of interests is also rather slighted. Interests, temperamental qualities and sentiments are obviously closely connected and, of course, reveal themselves in attitudes, but they must be distinguished if the interviewer is to understand the significance of the attitudes he perceives in a candidate.

Although Mr. Oldfield's conclusions are not to be accepted without qualification, his effort towards a radical understanding of the interview as a psychological tool is nevertheless of very real value.

A BIRD OBSERVER IN CORNWALL

Winged Company

Studies in Bird-Watching. By R. G. Walmsley. Pp. xiii+227. (London: Eyre and Spottiswoode, Ltd., 1940.) 7*s*. 6*d*. net.

IT is a coincidence that I should be able to review this attractive bird book, because, not long before his death, the author wrote to me. In his letter he mentioned that he had been reading a book, "Wild Birds in Britain", which I had written about that time, and he had been, he said, greatly impressed by the resemblance between that book and the manuscript he had written. He said he felt that he might well have been the author of my book, and he felt he must write and tell me this lest, if ever his manuscript should appear in print (he was very doubtful of this at the time) I should know that he had not been copying my own style and treatment of the subject.

"Winged Company" is written by a true lover of birds, for as with Edward Grey of Falloden, birds were his great joy during the last years of his life. The birds he watched so lovingly, and with such accuracy, were mainly observed in Cornwall. Raven and chough, peregrine and buzzard, gannet and kittiwake, shearwaters and terns, and the tribe of the divers, among the larger species; redwing and fieldfare, wheatear and skylark, the tribe of the warblers and the clan of the buntings among the smaller species. I was interested to read the author's statement that willow warblers "take a particular pleasure in tormenting Long Tailed Tits: they are like mischievous little boys chasing a party of fussy old ladies". I wonder if other observers have noted this.

He loved the wood warbler, which arrives "at a time when the beech leaves are most silky and diaphanous and the woods are filled with cool green lucencies". But surely the colour "beneath the wings of the Redwing" is not "scarlet" but rather cinnamon (p. 65). It is interesting to know (p. 70) that the first wheatear arrives on the Cornish coast during the first days of March. In the Isle of Skye it is the last week in that month before he is seen (the males always arrive first). I write this notice on April 12, yet I have seen no wheatear, and were he here he would be shivering under the lashings of an Arctic wind. I like the author's description of the male wheatear (p. 70):

"The male Wheatears at this period are brilliantly arrayed; pearl-grey, black, white, and a tint somewhere between salmon and apricot blend to produce a plumage of exotic beauty. . . . There is surely something Egyptian in the Wheatear's expression, a suggestion reinforced by its colouring, by the black and white fan of its tail, and by the bird's strange instinct toward the sand."

This book is one which will appeal to all those who love birds. The author's style is direct, simple, and bears distinction. For war-time days of paper shortage it is admirably reproduced. It is indeed a book to be read slowly, at leisure, to be fully appreciated, and the more one studies the wood-cuts by Denys Watkins-Pitchford, which form the illustrations, the more one is impressed by their accuracy. I like especially that showing buzzards circling over Zennor Cliffs (p. 195), but that of the peregrine's stoop at Rock Doves (p. 201) is fully its equal, and shows minuteness of observation and delicacy of delineation.

SETON GORDON.

PLANKTON AS A SOURCE OF FOOD

By Prof. A. C. Hardy, F.R.S.
University College, Hull

SIR JOHN GRAHAM KERR recently asked a question in the House of Commons and wrote a letter to *The Times*[1] proposing that a committee of biologists and engineers should be instituted to inquire into the possibility of obtaining food direct from the marine plankton.

One of the most surprising results of the "Discovery" investigations was the demonstration by Mackintosh and Wheeler[2] that the great rorquals, the Blue and Fin whales, became sexually mature and reach an average length of 75 ft. and 65 ft. respectively in *only two years* from birth; they are born 23 ft. and 21 ft. long after some eleven months of fœtal life. This prodigious mammalian growth, including the formation of great food reserves in the blubber, is built up entirely on a planktonic diet. It would certainly appear worth while to inquire if some of this wealth of food could not be taken directly from the sea to be used, if not for human consumption, as a valuable addition to the food of stock.

It is just fifty years since the late Sir William Herdman described in NATURE[3] how plankton formed a breakfast dish for a yachting party of eight. Johnstone[4] gives the following composition of the dry substance of copepod plankton: protein 59 per cent, fat 7 per cent, carbohydrate 20 per cent, chitin 4·7 per cent and ash 9·3 per cent. Gunther[5] found the oil content of zooplankton collected from the Isle of Man to vary between 15·05 and 19·3 per cent of dry weight.

No doubt a good deal of preliminary work would have to be done to see if the yield would be sufficient to warrant the cost of power and labour in its harvesting and preparation. Even if it was not an economic proposition for peace-time, the urgent need for food in war-time might put the matter in quite a different light.

Dr. George Clarke, of the Woods Hole Oceanographic Institution, wrote an article on the subject just before the War[6]. "According to a recent news report", he writes, "the German State Biological Institute at Heligoland is investigating the possibility of harvesting the plankton of the sea as a new food source for the German market to make Germany still more independent of foreign imports. Zooplankton was reported to have a nutritive value equivalent to the best meat and phytoplankton to be equal to rye flour."

Clarke considers that one might take "as an outside figure" a value of 0·1 gm. dry weight of plankton per cubic metre of sea water and that 750 gm. would be required to support one man per day assuming all the organic matter in the plankton to be assimilable. On this basis "each member of the population would require all the zooplankton from *at least* 7,500 cubic metres each day . . . . Using the largest net generally found practical (2 m. in diameter) at a fast towing speed (2 knots) and assuming a 20 per cent straining efficiency for a coarse net, a period of 2½ hours would be necessary to filter this volume of water. If several nets were used simultaneously, more men and larger boats entailing greater operating costs would be required." He ends his article by saying: "We are forced to conclude, therefore, that if the marketing of plankton on a commercial scale is to become a practical reality, either areas of greatly increased richness must be located or some method must be found for making the above rate of procuring plankton economically feasible."

Clarke's view of the matter might indeed have appeared discouraging had he not added the following footnote: "There might be some possibility of operating economically a filtering plant in a tidal flow between suitably located islands or in the entrance of an estuary." Here may well be the starting-point for such an experiment; if it should be successful, we, in the British Isles, are extraordinarily well placed for such an enterprise.

Up the west coast of Scotland there is an exceptionally rich plankton, richer than that upon which Clarke based his calculations, a plankton which supports the shoals of Loch Fyne herrings, attracts the basking sharks to the Firth of Clyde and has fed the rorquals which in years past made a whaling station in the Hebrides a paying proposition. In many of the long sea lochs, teeming with plankton, there is a strong tidal flow. In English estuaries huge tidal 'filter nets' have been used successfully by fishermen for generations. The sprat and whitebait fishermen of the Thames Estuary use 'stow nets' 200 ft. in length and having an opening of 20 ft. × 30 ft.; each net is streamed below a boat at anchor and is fastened by its bridles to the anchor chain. In the Bristol Channel (at Weston-super-Mare and Clevedon) nets with an opening 18 ft. square are streamed from the anchor chains of buoys so that they will swing as the tide turns. These nets are described in detail in that fascinating work, "An Account of

the Fishing Gear of England and Wales"[7], by the late Mr. F. M. Davis.

A swing net such as the last mentioned could be made of stramin (a strong openly woven fabric in common use for the collection of the larger zooplankton) supported by the application of longitudinal and transverse lengths of rope. It would have an opening of 30 square metres. Taking Clarke's estimate of a filtering efficiency of 20 per cent, it would filter 22,278 cubic metres of sea water per hour in a 2-knot tide way. The pressure on the net could be reduced by fitting a conical opening to the entrance of the net to cut down the water entering to suit its filtering efficiency, as in Hensen's plankton net. It could swing with the tide and fish in both the flow and the ebb. The 'cod-end' could be hauled up and emptied of the catch at slack water by two men in a small boat. In many positions in the Scottish sea lochs one could count on the equivalent of a tidal flow averaging 2 knots for at least 12 hours a day. The net could be fished near the surface at night and deeper during the day to accord with the diurnal vertical migration of the bulk of the zooplankton. It could be made to turn and fish inside out and so be reversed at each emptying of the cod-end in order to prevent the meshes becoming clogged, as they would if it were constantly used in one direction.

Ten such nets fishing for 12 hours would yield 267·3 kgm., or 5¼ cwt., *dry weight* of plankton a day, or enough to feed 357 people. It would seem likely that the very rich plankton off the west of Scotland might give an even higher yield than this, which is based on Clarke's estimate of 0·1 gm. dry weight of plankton per cubic metre of sea water.

If tests for yield could be made this summer with a few such nets placed at different points in the Scottish sea lochs and if at the same time researches were undertaken into the food values of the plankton and the best means of making it available for either human or animal consumption we might in time for next summer know if it would be worth while launching a large-scale effort to increase the country's food supply.

More than a thousand miles of drift nets were used in our herring fishery in the days of its prime. The herring grounds are now largely closed and the boats and crews otherwise employed. If trials were found to justify the above calculations, a hundred 'fleets' of tidal nets (each of ten nets looked after by two men) would yield 26¼ tons of plankton *dry weight* per day from the sheltered waters comparatively safe from enemy action. The plankton could be transported by boat or road to factories for its treatment at suitable points along the coast. Such a war-time emergency measure might well give rise to a regular peace-time industry. With practice the efficiency of the methods could be increased and perhaps in time it would be economically feasible to employ special ships to harvest the still richer plankton of the polar seas.

Sir John Graham Kerr's request that a committee should be set up by the Ministry of Food to inquire into the possibility of obtaining food from the plankton should not lightly be turned aside. In his question in the House of Commons he referred to modern types of mechanical separators; it would be important to investigate whether these would be more economical and efficient than the use of tidal nets.

[1] *The Times*, May 6, 1941.
[2] Mackintosh, N. A., and Wheeler, J. F. G., *Discovery Reports*, **1**, 259 (1929).
[3] Herdman, Sir William, NATURE, **44**, 273 (1891).
[4] Johnstone, J., "Conditions of Life in the Sea", Cambridge (1908).
[5] Gunther, E. R., *J. Exp. Biol.*, **11**, 192 (1934).
[6] Clarke, G. L., *Science*, **90**, 602 (1939).
[7] Davis, F. M., Min. of Agric. and Fisheries, Fishery Investigations, Series II, 15, No. 2 (1936).

NATURE OF THE INTRAMOLECULAR FOLD IN ALPHA-KERATIN AND ALPHA-MYOSIN

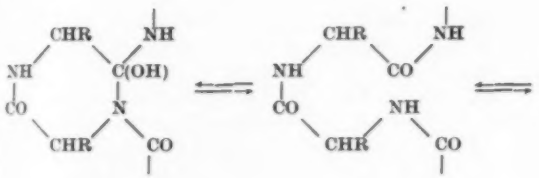
By Dr. W. T. Astbury, F.R.S., and Dr. Florence O. Bell,
Textile Physics Laboratory, University of Leeds

KERATIN, the protein of mammalian hairs and related epidermal tissues, the fibrous proteins of the epidermis itself, and myosin[2], the principal protein of muscle tissue, all fall into one great group of fibrous proteins that have a common molecular configuration and similar long-range elastic properties. This generalization follows from a series of X-ray and supporting investigations that have been described among other places in NATURE[1]. There will perhaps be no need then to summarize them again here, beyond recalling that the structural unit of the group is a 'grid' consisting of long polypeptide chains cross-linked by means of their side-chains, that the main-chains of this grid are not normally in the extended configuration but are thrown into a sequence of folds transverse to the side-chains, and that when the fibres are stretched the grid is pulled

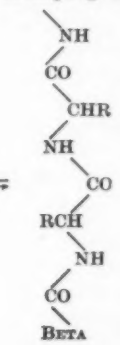
out flat, only to return to its folded configuration when the tension is released. The normal folded configuration we have called α, the extended configuration β, and the reversible intramolecular transformation from α-keratin (or α-myosin) to β-keratin (or β-myosin) is the basis of the remarkable long-range elastic properties of this group of protein fibres.

The chemical constitution of the group changes unmistakably as we pass from keratin on one hand to myosin on the other, though the main features (not the fine structure) of the X-ray diffraction pattern remain always the same, especially the strong meridian reflexion of spacing about 5·1 A. Even without the confirmatory evidence of the elastic and other properties, this is sufficient to demonstrate convincingly that there is some intramolecular conformation common to the whole group, something analogous to the benzene ring, say, in aromatic chemistry, that overrides within limits variations in empirical constitution. The implication, of course, is that the conformation in question is the intramolecular fold responsible for the long-range elastic properties, and it is a matter of stereochemical urgency, for the great keratin-myosin group in particular and for proteins in general, to discover its exact nature.

Our earlier theory was that the transformation involves the opening of hexagonal rings, thus :



ALPHA



BETA

and more recently Wrinch has developed the same idea systematically into her 'cyclol hypothesis'. But now the tide of evidence is flowing strongly against it [2, 4], and especially the experiments of Neurath[3] with up-to-date scale models have shown conclusively that there is simply no room for the side-chains when the main-chains are folded in this way. It seems that we have to accept the fact once and for all and bend ourselves to seek a new solution.

The β-configuration may be represented diagrammatically as in Fig. 1. There is no stereochemical difficulty about it ; the side-chains lie alternately on one side and the other of the main-chain, well out of one another's way. The unstretched, or α-, configuration is formed from the β- by throwing the main-chains into a series of regular folds (in terms of Fig. 1 these folds undulate above and below the plane of the paper), and the operations of extension and contraction leave the integrity of the grid unchanged.

Now put as concisely as possible, the experimental and general structural conditions[4] to be satisfied by the α-β transformation are as follows :

(1) The α-form must be about half as long as the β-form.

(2) The density must remain practically constant.

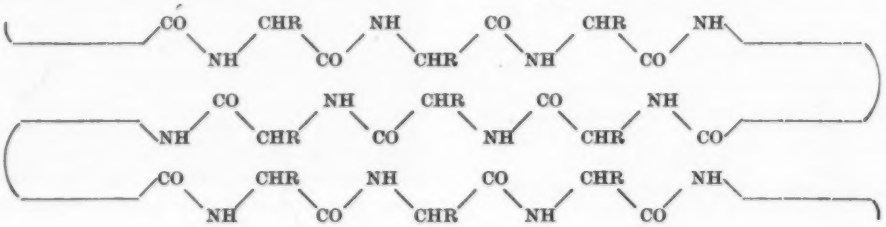
(3) The folds must repeat at a distance of about 5·1A.

(4) The side-chains must stand out alternately on one side and the other of the plane of the fold.

(5) The folds must be nowhere so sharp as to leave insufficient room for the side-chains.

Is it feasible to devise an intramolecular fold satisfying all these conditions that could conceivably, pending complete chemical analyses, be adapted equally well to the constitution of myosin as to that of keratin ? We believe that it is ; and what is more, the proposed solution hints at a principle fundamental for all proteins.

Consider condition (2). It is really nothing new or unique, for almost all proteins have densities in the neighbourhood of 1·3, the density of wool keratin. This order of density is what we should expect for a parallel polypeptide chain system in the β-configuration[7], and the fact of its being observed again in the corpuscular (or globular) proteins, both before and after denaturation[8], provides one of the best arguments we have in favour of regarding these proteins also as effectively fibrous. The inference is that folds in polypeptides are in general of the following type[9] :



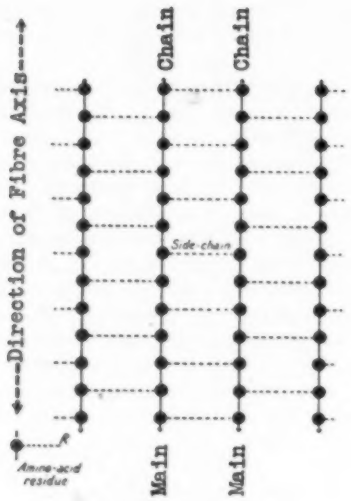


Fig. 1.

A POLYPEPTIDE 'GRID' IN THE β-CONFIGURATION.

with the side-chains projecting alternately above and below the plane of the folds.

If now we try in this way to accommodate the other conditions, we find at once with the aid of models that 5·1 A. *is just about the shortest distance at which it is possible to fold a polypeptide chain so as to leave the side-chains alternately on one side and the other of the fold*, and further of course, if the fold is approximately square, it doubles its length too when opened out. We have thus satisfied the first four conditions, and there remains only to examine more closely the fate of the fifth. Actually, *the side-chains are seen to be grouped in close-packed triangular columns first on one side of the fold and then on the other.*

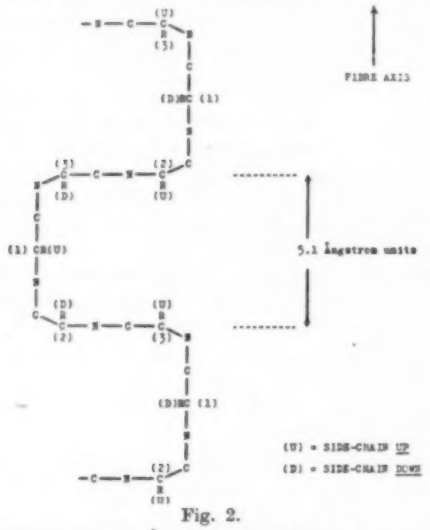


Fig. 2.

PROPOSED BASIS OF THE INTRAMOLECULAR FOLD IN α-KERATIN AND α-MYOSIN.

The sequence of amino acid residues and the inter-relations of the side-chains are shown diagrammatically in Figs. 2 and 3, while Figs. 4*a* and 4*b* are photographs of an atomic model, built to scale[10], of one fold and part of the fold adjacent to it. In Fig. 4*a*, which illustrates the packing of the side-chains and corresponds to that part of Fig. 3 surrounded by a dotted line, the large spheres represent the second CH_2-group counting from the main-chain (assuming for our purpose

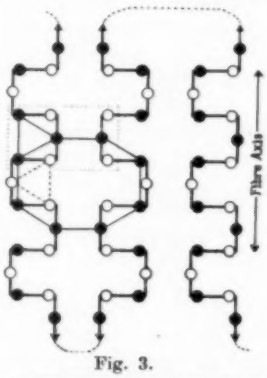


Fig. 3.

ILLUSTRATING THE CLOSE PACKING OF SIDE-CHAINS IN THE α-FOLD OF KERATIN AND MYOSIN.

—represents the direction of the main-chain; ● represents a side-chain pointing *up* from the plane of the diagram; ○ represents a side-chain pointing *down* from the plane of the diagram.

side-chains at least two carbon atoms long), but in Fig. 4*b*, the other face of the model, the side-chains have been removed to reveal the form of the main-chain. The diagrammatic square has been distorted somewhat so as to build a 'hydrogen bridge' between opposing CO- and NH-groups within the fold, and it has also been found necessary, in order to meet the dimensional requirements of the X-ray photographs, to postulate hydrogen bridges between adjacent folds. Altogether, the arrangement seems very satisfactory indeed—in fact the various atoms and groups fit together so neatly that it is scarcely possible to construct the model in any other way if the five basic conditions are to be observed. A particularly nice point is this, that the shortest permissible width of fold is rather greater than the distance of closest packing of alkyl chains, and therefore the tendency to close packing is slightly in excess of what we need: conceivably it could fold the backbone a little tighter still, but the bounds are set just before that—and so the *main* pattern always repeats at the same distance, 5·1 A. As soon as the side-chains leave the confines of the backbone they presumably cling together rather more closely, and if they want to open out again

somewhat to allow for the bulkier of the terminal groups, they can do so by making use of the octagonal gaps in the structure (see Fig. 3).

The above solution of the keratin-myosin problem has been obtained by induction, but the more correct treatment would appear to be by *deduction* from the principle of close packing. The principle is familiar enough in structures built from ions and small molecules, but it must apply also to the mobile parts of single large molecules, such as the side-chains in proteins. We should like to put it forward here, in fact, as probably one of the great general principles of protein structure. It leads immediately, for example, to the present solution of the keratin-myosin problem, for obviously the arrangement shown in Fig. 3 is one of the first we should arrive at. No longer need we be surprised at the remarkable 'accident' that β-keratin is just about twice as long as α-keratin and has just about the same density: we see now that *these supposed conditions are inevitable consequences of close-packing the side-chains in a simple, regular pattern.*

The accompanying table summarizes the comparative chemical constitutions of wool keratin and rabbit myosin as derived with the help of X-ray data in the manner already described in this journal[11]. The table is frankly idealistic,

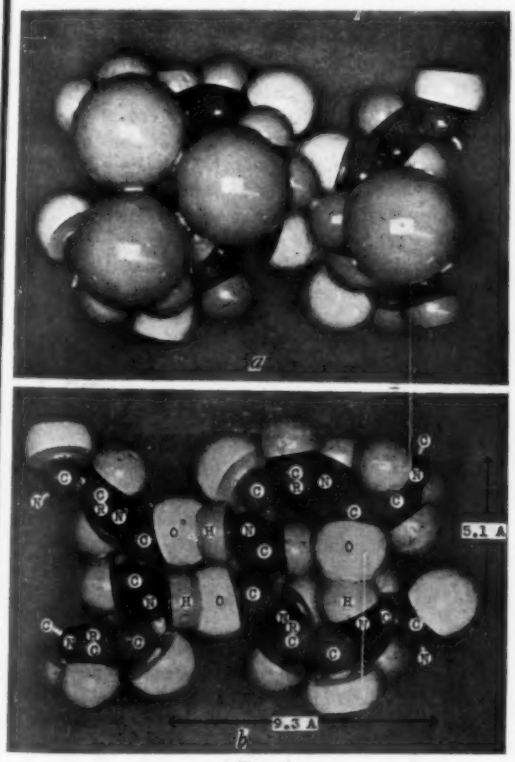


Fig. 4.

COMPARATIVE CHEMICAL CONSTITUTIONS OF KERATIN AND MYOSIN

Amino acid	Proposed numbers of residues of each amino acid in a total of 576	
	Wool keratin	Rabbit myosin
Glycine	64	48 (?)
Alanine	32	48
Valine	24	24
Leucine, etc.	64	64
Phenylalanine	16	16
Proline	36 (or 32)	3
Methionine	3	16
Cystine/2	72 (or 64)	8
Serine	64	48 (?)
Threonine	32	48 (?)
Tyrosine	16	18 (?)
Tryptophane	6	3
Aspartic acid	32	48
Glutamic acid	64	96
Arginine	36 (or 48)	32
Lysine	12	48
Histidine	3	8
Totals	576	576
Residues as amides	64	64
Average residue weight	118	116 } approx.
Molecular weight	68,000	67,000 }

incomplete and tentative in parts[12]; but in any event it is obvious that the two proteins differ considerably in empirical constitution. There must therefore be a certain interchangeability, or rather potential interchangeability, between the residues forming one structure and those forming the other, an intramolecular counterpart of mixed crystallization[11]. Provided a residue is of the right 'type', apparently that is all that matters, within limits.

The great lesson of the keratin-myosin group is that a protein is essentially a pattern of charges associated with a close-packed forest of side-chains, the polypeptide chain being an infinitely variable device for building up distributions of charges and presenting them to given chemical environments. A typical, though not necessarily universal, unit of protein architecture is a sheet (or ribbon) of folded main-chains with side-chains projecting from either face. Several years ago (also in the pages of this journal) we gave strong reasons for supposing that the native egg albumin molecule consists of four such sheets superposed[13]. The further developments of the keratin-myosin theory outlined in this article only tend to confirm the suggestion.

[1] See also Astbury, W. T., Jubilee Memorial Lecture of the Society of Chemical Industry, *Chem. and Ind.* (in press), and **60**, 41 (1941).
[2] Astbury, W. T., and Dickinson S. *Proc. Roy. Soc.*, B, **129**, 307 (1940).
[3] Pauling, L., and Niemann, C., *J. Amer. Chem. Soc.*, **61**, 1860 (1939).
[4] Astbury, W. T., *Trans. Faraday Soc.*, **36**, 871 (1940).
[5] Neurath, H., *J. Phys. Chem.*, **44**, 296 (1940).
[6] Astbury, W. T., and Street, A., *Phil. Trans. Roy. Soc.*, A, **230**, 75 (1931); Astbury, W. T., and Woods, H. J., *ibid.*, A, **232**, 333 (1933); Astbury, W. T., and Sisson, W. A., *Proc. Roy. Soc.*, A, **150**, 533 (1935); Astbury, W. T., *J. Text. Inst.*, **27**, P282 (1936); Woods, H. J., *Proc. Roy. Soc.*, A, **166**, 76 (1938).
[7] Astbury, W. T., *Trans. Faraday Soc.*, **29**, 193 (1933).
[8] See, for example, Bull, H. B., Cold Spring Harbor Symposia on Quantitative Biology, **6**, 140 (1938).
[9] Astbury, W. T., Dickinson, S., and Bailey, K., *Biochem. J.*, **29**, 2351 (1935).
[10] Pauling, L., "The Nature of the Chemical Bond" (1939).
[11] Astbury, W. T., NATURE, **140**, 968 (1937); Astbury, W. T., and Bell, F. O., Cold Spring Harbor Symposia on Quantitative Biology, **6**, 109 (1938).
[12] A full discussion will be given elsewhere. In the meantime, we should like to make it clear that no responsibility for the precise residue numbers chosen attaches to the protein analysts whose experimental results have been utilized.
[13] Astbury, W. T., NATURE, **137**, 803 (1936). Pauling has recently put forward a similar suggestion in *J. Amer. Chem. Soc.*, **62**, 2643, (1940)).

THE CIVILIAN POPULATION UNDER BOMBARDMENT

By R. J. BARTLETT,
KING'S COLLEGE, LONDON

A MEETING of the British Psychological Society was held at Nottingham during April 17–21 and, among other matters, dealt with the effects of war conditions on the civilian population. In particular, Dr. Margaret Lowenfeld introduced the problem of man in the mass, while Dr. H. Crichton-Miller set out the effects on the individual of air bombardment. Discussion emphasized that more should be done by psychologists in air-raid shelters and evacuation areas, and a further meeting will be held to consider the whole situation.

Man in the aggregate shows behaviour that cannot be foretold from the study of man as an individual; but there is little that ranks as scientific knowledge of such behaviour. Many assumptions about mass behaviour derive from introspection, the study of animal behaviour and from psychopathology. The inadequacy of such a basis is witnessed by the breakdown of the theory that, brought to its senses by the horrors and foolishness of 1914–18, mankind would replace savage war by civilized consultation; and by the fact that loudly heralded 'panic' has, so far, failed to materialize.

There is scarcely any acceptable published material on which to base decisions of such practical importance as the kind of shelters human beings prefer: whether deep or surface, noisy or quiet, small or large. We do not know the conditions that promote or hinder courage, or how best to protect children. We do know that groups of the population behave peculiarly; that in some areas old men and women refuse removal to safety from nightly bombardment, that panic does not occur where physiologically it should, and that noise is more frightening than bomb destruction to some, while it is comforting to others.

With the same people nightly in the same shelters, subjected to events varying from mere boredom to the horrors of an inferno, almost laboratory conditions are provided for testing theories of instinctive activity and volitional control. Such an opportunity ought not to be neglected by social psychology. Concerted effort should be made to secure unbiased psychological truth and to put it to practical use. It is time that factually based reasoning and planning were given a chance to displace 'trial and error' methods.

The official explanation of absence of panic under bombardment and presence of the 'we can take it' attitude would seem to be our much-applauded morale. Therein lies a danger. Moral courage eliminates self-pity and malingering, and, if functional disability is due to these, it is something to be ashamed of and despised. But functional disability resulting from air bombardment is a serious reality and has nothing whatever to do with morals. In the War of 1914–18 the functional effects of high explosives were clearly recognized and labelled shell-shock. For various reasons it was decided to cut out shell-shock from the present War. However, the naïve conviction that a symptom can be eliminated by forbidding it a name broke down. The symptom reappeared and clinicians named it blast-concussion.

The incalculable effect of blast on plate-glass windows is a commonplace. It is reasonable to suppose that similar effects of compression and suction on elastic abdominal walls displace the fluids of the body with extreme violence to and from the skull-contained brain. The strain thus imposed upon the delicate structure of the central nervous system is very severe and in fatal cases punctate hæmorrhages are found, *post mortem*, not only in the meninges but also throughout the brain substance.

Blast-concussion, in varying degrees of severity, is to be expected after exposure to an explosion. It bears no relation to morale, courage, discipline or any other ethical virtue, and has no intrinsic connexion with psychology. Extrinsic association is, however, very common. The effects on a person suffering from acute anxiety differ from those on one knocked out with 'no time to be frightened'. A hysterical person will exploit the effects in the same unconscious or semi-volitional way in which other disabilities are exploited. An alloy of organic concussion and emotional fear is common. Each factor should be dealt with, and the assumption that all unwounded patients are malingerers should be carefully avoided. The obviously wounded person is in a relatively happy position. He is ensured the rest essential for cure of concussion, and spared the feeling of loss of prestige from being disabled without visible trauma. Thus the worst effects of blast-concussion are seen in the unwounded.

Consider next physiological conditions influencing air-raid reactions. An exhausted man, with his supply of blood sugar at fasting level or below it, reacts badly to fear of death or danger. Anæmia and anoxæmia lead to despondency, apathy and inertia on one hand and to mental confusion and

uncontrolled behaviour on the other. Toxæmia lowers the whole resistance of the organism. With women there is also the varying emotional effects of the menstrual cycle, lactation and the climacteric. Again, in reaction to fear there is the influence of the adrenal glands. Normally fear produces an adrenal response which mobilizes available glucose, increasing muscular tone and enhancing activity which issues in 'fight or flight'. In troops about to attack, aggression should be at a maximum; but with civilians exposed to bombardment the natural reactions of 'fight or flight' are inappropriate, and fortitude, endurance, self-control are needed. In the first we have an instinctive pattern of behaviour, in the second a civilized pattern of conduct. In the absence of opportunity for retaliation or escape a severe strain is placed upon the efficiency of cortical control. Fear of death or suffering is endured in a latent or overt way. If latent it constitutes anxiety, if expressed we call it hysteria. The hysterical appeal drains off anxiety which has been accumulated by interference with the 'fight or flight' mechanism. Anxiety is the price man pays for a culture that demands inhibition of fear and hate reactions.

All this can be seen in the shelter situation under bombardment. Crude pugnacity in one man picks a quarrel with the shelter warden on wholly inadequate grounds. Flight reaction in another refuses the protection of the shelter and drives away, on and on, until the petrol supply is exhausted. In either case the breakdown of cortical control results in an instinctive reaction to fear. With realization that neither fight nor flight is a reasonable way out, the anxiety case, trembling and sweating, alert, taut and incapable of relaxation, scarcely controls himself as explosion follows explosion, while the hysteric in many ways proclaims the need of compassion, admiration or interest, and takes refuge in imagined protection of others. Still more common is anxiety-hysteria in which a limited control is unable to restrain a partial publicity campaign, but, nevertheless, succeeds in enduring a measure of unrelieved fear.

In many cases no one factor will fully account for the unhappy condition of the patient. A case was quoted where the recognized causes were: (1) dental sepsis, (2) gross ill treatment in childhood, (3) unfaithful marital life charged with guilt and fear. The elimination of any one of these factors would have modified the character of the breakdown. Each played its part in reducing a powerfully built, athletic man to a trembling, sighing, restless mass of anxiety when his house was demolished just after he and his family had taken cover in a public shelter.

OBITUARIES

Dr. Otto Pettersson

OTTO PETTERSSON, chemist, physicist and hydrographer, was born in Gothenburg in February 1848, and died there on January 16, 1941. He took his degree at Uppsala in 1882, and began work as an inorganic chemist, studying selenium and beryllium while his friend Theodor Cleve was studying the rare earths; but he soon turned to physical chemistry, which was coming to the front just then, and had a long paper in NATURE on a "New Principle of Measuring Heat", in 1884, nearly sixty years ago (NATURE, **30**, 320; 1884). Heat phenomena in general, specific heats, latent heats and heats of crystallization, led him towards hydrography by way of the temperature and ice-conditions of the Baltic and Arctic Seas; and he got his chance when Nordenskiöld brought the *Vega* home and asked him to report on the hydrography of the Siberian Sea. A careful determination of the maximal density-point of sea-water at various salinities formed part of this report, and the work brought him into contact with John Murray, and with Tait, who was then busy with the temperature observations of the *Challenger*.

Pettersson had a family place at Holma, in Bohuslan, where the Baltic was at his very door, with all its fascinating hydrography. F. L. Ekman had made a good start towards its investigation, but there was plenty left to do; and Pettersson with his friend, Gustav Ekman, wrote one paper after another in the early 'nineties, mostly on the hydrography of the Skagerrak. Two problems interested him then and ever after. Where ocean water enters the inland sea it dips down and lets the fresh water float out above the salt; each has its own phenomena, and the submerged surface of discontinuity is the seat of waves and tides which may reach considerable amplitude. Under such conditions as these Nansen had encountered 'dead water', and Wilfred Ekman had explained that old mystery once for all; our submarine commanders were mightily perplexed by the same stratification when they first entered the Skagerrak in the beginning of the War of 1914–18; and here Otto Pettersson found what he called the Gulf-stream water' rolling in, deep down, invisible.

The second problem, closely associated with the first, lay in the vicissitudes of the Swedish herring fishery. For Bohuslan had been the seat of the great Hanseatic herring fishery in the thirteenth and fourteenth centuries, until it came to a sudden end in the fifteenth, and moved out, to the enrichment of Holland, into the North Sea. Pettersson found an explanation of this great historical event (and of certain other catastrophies such as the formation of the Zuyder Zee) as part of a long-period phenomenon,

due to hydrographical and, in turn, to astronomical tide-producing conditions. At a certain rare configuration of sun and moon, he said, great underwaves rolled into the Baltic from the ocean, and brought the herring where they now no longer come. At the same time the fresh waters were reduced to a shallow surface-layer, so apt to cool down and freeze that severe winters and a frozen Baltic were a common thing. All this work of Pettersson's is extraordinarily interesting; but it is very complex and very difficult, and perhaps the time has not yet come to judge it.

Pettersson and his friends were pioneers of oceanography, and it was they who brought a little company together in Stockholm, in 1899, to plan the international "Exploration of the Sea". Nansen was there, and John Murray and Otto Krümmel; Cleve was there, once a famous chemist, now one of the chief students of the micro-fauna of the surface of the sea; Gustav Ekman came from Gothenburg and Victor Hensen from Kiel and Friedrich Heincke from Heligoland; and Johann Hjort and Martin Knudsen and I who write these lines were among the younger men. It was an honour and an education to be there.

Otto Pettersson lived two happy lives, as farmer and as scientific man. "I am a peasant," he was wont to say; it was the only English word he ever mispronounced. When I once paid him a visit at Holma he had some sixty or seventy beautiful Frisian cows in his model dairy, and he had lately built his laboratory on a little rocky island just over the way. The cliff went sheer down, and the workroom actually overhung the deep water of the Gulmarfjord. The little place was full of gadgets; water could be pumped from various depths, and all sorts of recording instruments ticked away. A copper vessel floating on the surface of discontinuity rose and fell with the submarine waves, and transmitted their motion to a recording drum. In fact, the devising of apparatus was one of Pettersson's special gifts, perhaps his greatest gift of all; the water-bottle which goes by his name and Nansen's was really his. Nansen, for all I know, may have somewhat improved it, and he used it and made it known; but it was Otto Pettersson who made it first, and gave it to Nansen to take with him on the *Fram*. Pettersson was fertile of ideas, ingenious in experiment, enthusiastic over all he took in hand to do. Age did not wither him. He kept his sturdy frame, his active mind, his warm heart, his cheerful countenance, even to extreme old age.

D'ARCY W. THOMPSON.

Mr. Francis Druce

MR. FRANCIS DRUCE, who was killed recently by enemy action, was well known as a botanist and collector of botanical books. He was born on January 3, 1873. Educated at Harrow and Magdalen College, Oxford, he entered the long-established firm of Druce and Attlee. In 1910 he was forced by ill-health to retire from active participation in the business (from which he completely retired in 1923), and his great love of "Nature in all her moods" led his energies into the study first of meteorology, then of his chief interest, botany. His legal experience, good judgment and methodical habits made him an ideal treasurer of scientific societies to which he belonged. In this capacity he served the Royal Meteorological Society for two periods, 1913–1918 and 1925–1932. He was treasurer of the Linnean Society of London from 1931 until the autumn of 1940, when he became master of the Innholders' Company, of which, following the family tradition, he had previously been clerk for some years. Of the Botanical Society of the British Isles he became treasurer a few years before his death, and also took over the secretaryship when the secretary was called up for active service.

Druce formed extensive meteorological and botanical libraries. The former he presented to the Royal Meteorological Society some seven years ago, but he continued meteorological observations until his death, and when travelling always carried with him a maximum-minimum thermometer. His botanical library, except for most of his rarer herbals, was in great part destroyed in the fire which followed his death: it has been the subject of an article in the "Private Libraries" series of the Times Literary Supplement (Dec. 31, 1938). His herbarium, which mainly consisted of British plants collected by himself during the past twenty-five years, and which included almost every British species which it is possible at the present time to see in native haunts, was completely destroyed. Since 1919 I have visited most parts of the British Isles in his company, hunting rare desiderata, these ultimately becoming reduced to the 'forlorn hopes' of almost or quite extinct species. He was intrepid on rocks, and appeared quite comfortable standing on the edge of a cliff examining the slopes below through his field-glasses, which he generally carried to observe birds, of whose song (as also of good music) he was a great lover. He acquired a very good knowledge of the British flora and had a good eye for plants, although he himself never tackled any of the critical genera and preferred others to write up the results of his expeditions. He remained unmarried, but took great interest in the boys' clubs of his parish church in Chelsea, of which he was a strong supporter. Generous and loyal, he will be missed by a wide circle of friends.

A. J. WILMOTT.

Dr. C. G. Lamb

WE regret to record the death of Dr. Charles George Lamb, emeritus reader in electrical engineering in the University of Cambridge, on May 4.

Born in 1867, Lamb originally wished to become a professional musician; when the early death of his father made this impracticable, he went to the University of London, where he attended courses on zoology, and for a time contemplated a medical career; but he ultimately decided to study electrical engineering at the City and Guilds College, where as a student he helped to test the first alternating current transformer that was brought to Great Britain. After graduating, Lamb went to Cambridge in 1891 to assist the late Sir Alfred Ewing in his researches on the magnetic properties of iron; in the same year

he was appointed University demonstrator in mechanism and applied mechanics, a post which he held until he was appointed University lecturer in electrical engineering in 1903.

During the War of 1914–18, Lamb acted as head of the Department of Engineering; and thereafter, in 1921, the post of reader in electrical engineering was created for him, and ceased to exist on his retirement from reasons of health, in 1931. During the forty years he was teaching in Cambridge, Lamb watched and helped the growth of the Engineering Laboratory from insignificant beginnings to one of the largest departments of the University, and he is remembered with gratitude and affection by generations of students.

One of Lamb's distinguishing characteristics was his versatility; his interests and knowledge of matters remote from his own particular work were astonishingly wide. He could hold his own in discussions on such diverse matters as history, medicine and psychical research, so that experts in each subject were astonished when afterwards told that the man to whom they had been talking was not a specialist in their own line of research. His encyclopædic knowledge, practical ability, and readiness to take any amount of trouble whenever his help was asked were of great value to his friends, and to the University, especially in his capacity of a syndic of the University Press, an office to which he was repeatedly elected for many years.

Lamb spent most of his spare time in collecting and studying insects. He specialized on the flies, working for some years with Dr. David Sharp, and such was his ability in this direction that he became a recognized authority on certain groups of the Acalypteræ, especially the Ephydridæ and the Drosophilidæ, describing many new species. He was a real naturalist, and was a mine of information on the habits and life-histories of the insects he studied. His most important research was the study of the Diptera of the Seychelles, of the 428 species of which 28 genera and 311 species were previously unknown. He also did most valuable work in the Insect Department of the University Museum of Zoology, where he was in effect honorary curator of the Diptera for many years. For his zoological work, the University conferred upon him the degree of Sc.D. in 1923, and on his retirement from the Engineering Laboratory in 1931 he was created emeritus reader in electrical engineering.

Lamb never lost his early interest in music; although of late years even his most intimate friends could seldom prevail on him to play to them. As a freemason, he was a well-known figure in both town and University, and attained high rank. As a lecturer, he sometimes failed to appreciate that his mind worked faster than that of any but the most able of his audience, but he never grudged the time to explain privately any difficulties. To Cambridge zoological research he was for twenty years the valued referee whenever mathematical conceptions were involved. No student, colleague or friend ever asked his help in vain. C. R. C.

Mrs. Beatrice Bateson

THE recent death of Mrs. Beatrice Bateson, widow of William Bateson, F.R.S., has meant more than the loss to her own immediate friends. A link with the past has been broken, and many of his former pupil and colleagues will recall the integral part she played in those memorable days at Grantchester or Merton—a Saturday afternoon, a Sunday lunch—where the sense of intellectual freedom and curiosity, the spaciousness and the humour, were of her making as well as of his. She was always there to help, whether it was Japanese prints, embroideries, a display of home art, the chicken-pens or the greenhouses that formed the absorbing interest of the moment.

In recent years, when her own talents and her own energy had to stand alone, Mrs. Bateson's labours were mainly threefold; she made her garden in Sussex a delight, and with her needle she produced embroideries of great beauty of design and execution. But more important than trowel or needle was her piano; even within a few months of her death, under able and kindly guidance, she was mastering the intricacies of Bach with the enthusiasm and intensity of youth.

To Mrs. Bateson is due the biographical sketch of her husband, published in 1928: "William Bateson, F.R.S., Naturalist, His Essays and Addresses, together with a Short Account of his Life", which must form an important work of reference to some future biographer.

Of their sons, the eldest was killed in the War of 1914–18, and the second died in London shortly after. Gregory Bateson, the anthropologist, now working in America, is the youngest and only surviving son. Mrs. Bateson was the third daughter of Dr. Durham.

Her single-minded devotion to the things of the mind will remain embodied in the memory of her music-room in Sussex—the adapted bakehouse of the small Mill House. Two grand pianos of the smallest size could just fit in; on the window-sill stood a pot or two of her orchids, while one window looked straight into her beloved miniature greenhouse. On the walls and in the book-cases were many treasures, ranging from Blake to the Chinese, each eagerly acquired in the early days, each loved for its own sake and for its associations. In that room was no place for ignorance or for idleness.

WE regret to announce the following deaths:

Mr. E. O. F. Brown, president of the Institution of Mining Engineers, on May 22, aged fifty-nine.

The Right Hon. Lord Cadman, G.C.M.G., F.R.S., Chairman of the Anglo-Iranian Oil Company, Ltd., and the Irak Petroleum Company, Ltd., emeritus professor of mining and petroleum technology in the University of Birmingham on May 31, aged sixty-three.

Prof. Oskar Loew formerly professor of plant physiology in the University of Berlin, aged ninety-seven.

Dr. R. Campbell Thompson, F.B.A., Shillito reader in Assyriology in the University of Oxford, on May 23, aged sixty-four.

NEWS AND VIEWS

The Right Hon. Winston Churchill, F.R.S.

UNDER a statute of the Royal Society which provides for the election of persons who either have rendered conspicuous service to the cause of science or are such that their election would be of signal benefit to the Society, the Right Hon. Winston S. Churchill was elected a fellow of the Royal Society on May 29.

The admission of the Prime Minister to the Royal Society, although to some extent in accordance with precedent, is in Mr. Churchill's case thoroughly justified by his interest in, and appreciation of, scientific developments. Time and again, in speeches in the House of Commons and in broadcast addresses, he has stressed the importance of making the fullest possible use of science to combat the "perverted science", as he has rightly termed it, of Nazism, which has been nurtured for the purpose of destroying life and property and enslaving the souls of men. He was quick to appreciate the use which was being made by our enemies of scientific developments, and equally swift to realize that scientific men in Great Britain have the knowledge and skill to counter their attacks. Moreover, he has not hesitated to pay public tribute to their work, as witness his statement in the House of Commons when he proclaimed the defeat of the magnetic mine, which for a few weeks had taken a heavy toll of our ships. This awareness of the significance of scientific developments culminated in the appointment last October of the Scientific Advisory Committee, to which reference has frequently been made in these columns, whereby the leading research institutions of the country are enabled to maintain direct contact with the Cabinet itself. Mr. Churchill's election to the fellowship of the Royal Society is a timely recognition by the world of science of his services to the British Empire, to the cause of democracy and not least to the cause of science itself.

The Royal Society: New Foreign Members

PROF. J. B. CONANT and Dr. K. Landsteiner have recently been elected foreign members of the Royal Society.

Prof. J. B. Conant, For. Mem. R.S.

PROF. JAMES BRYANT CONANT held the position of professor of chemistry and head of the Chemical Faculty at Harvard up to 1933, when he was elected to the high office of president of the University. In relinquishing his post in the Department of Chemistry, although the University as a whole gained, American science lost to a large extent one of its most distinguished investigators. Nevertheless, Prof. Conant never abandoned chemical research, and has published original work continuously up to the present time. His researches cover an impressive range of subjects, and are especially noteworthy by the novelty of the physical chemical approach and the skill with which this has been employed in the field of organic chemistry. Although it is impossible adequately to indicate the scope of his work in a short summary, some idea of his versatility can be gained by mention of some of the major themes. These include: (*a*) A comprehensive study of the addition of phosphorus halides to organic compounds in the course of which entirely novel reactions were brought to light; (*b*) Numerous publications dealing with the study of oxidation-reduction potentials of organic compounds, including hæmin and related substances; (*c*) Investigations of free radicals and the kinetics of their formation; (*d*) The application of physical methods to structural problems of organic chemistry; (*e*) The study of reaction mechanism as applied both to substitution displacements and keto-enol tautomerism; (*f*) Researches on the constitution of chlorophyll and the related porphyrin groups; (*g*) Biological-chemical applications of induced radioactive indicators.

In all his numerous publications one is struck with the freshness of outlook with which Prof. Conant approaches the subject. His intuitive faculty and deep insight into the fundamentals are matched by notable experimental skill. The work with which his name is most clearly associated is that relating to the constitution of chlorophyll. In this field his contributions have been outstanding; he cleared up many of the more obscure points in the structural relationship of the chlorophyll group, and contributed matter of the highest originality. His work is entirely independent of that of Hans Fischer and, although not so extensive in scope, certainly of equal merit. To specify a few major examples of his chlorophyll work one might cite the fact that he was the first to provide conclusive evidence of the close connexion between the green derivatives of chlorophyll and porphyrins. Similarly, his work on the 'allomerization' of chlorophyll is peculiarly fascinating; he was the first to recognize it as an oxidation, a discovery which led directly to a complete understanding of this complex phenomenon. He initiated with Prof. Kistiakowski the important series of exact measurements of the heats of organic reactions which the latter has been carrying on up to the present time. Since his appointment to his present office he has devoted his energies and talents to raising the standard of teaching and research in universities, and to promoting liberty of thought and expression. Prof. Conant has also had a considerable influence on the development of the organic chemical industry in the United States, and in this connexion it is worthy of note that his scientific initiative as a consultant was an important factor in the success of Carothers's work on new polymers. Finally, during the past three years he has devoted as much of his time as his many duties would permit to educating public opinion in the United States to appreciate the full value of maintaining a true democratic outlook, and his present appointment by President Roosevelt testifies to the success of his efforts and the confidence the latter has in him.

Dr. K. Landsteiner, For. Mem. R.S.

WORKERS in the field of medical research in Great Britain will wish to join in congratulating Dr. Karl Landsteiner, of the Rockefeller Institute in New York, on his recent election, and will regard the honour as being a well-merited tribute to the high level of the scientific work he has pursued with unremitting vigour during the past forty years. Three outstanding achievements will forever be associated with his name: the discovery of individual differences in human blood which account for the four well-defined groups; the demonstration, together with E. Popper, that the causal agent of acute poliomyelitis is transmissible to monkeys; and the series of notable contributions he has made towards elucidating the nature of the specificity of immunological reactions.

Dr. Landsteiner was an assistant in the Institute of Pathology of the University of Vienna when, in 1901, he first published his work on iso-agglutination and the blood groups. Even at this early date he was aware of the probable significance of his results for medico-legal purposes, and in the practice of blood transfusion; and the value of his pioneer researches on the subject was attested when, in 1930, he was awarded the Nobel Prize in Medicine. The two first papers on the experimental transmission of poliomyelitis to monkeys appeared in 1908 and 1909, and they pointed the way to the subsequent intensive study by himself and by many other workers of the mode of transmission of the causal virus and of its neutralization by a specific immune-serum. In later years Landsteiner and his collaborators have been occupied chiefly with the chemical aspects of immunity. Their investigations and, in particular, the ingenious experiments with artificially conjugated antigens and the corresponding immune-sera have shed much light on the nature of the serological specificity of proteins and cell antigens.

Plankton as a Source of Food

THE interesting article which we publish in another column (p. 695) is of special importance inasmuch as it is from the pen of a distinguished leader in the investigation of marine plankton and its distribution. As the first occupant of the chair of zoology in University College, Hull, Prof. Hardy has wisely borne in mind its proximity to the great fishing-port of Grimsby, and has directed the policy of his department along lines which, as he believes, will lead towards increased prosperity of the fishing industry. The ingenious apparatus which he has devised for towing behind a moving vessel and registering a continuous record—quantitative and qualitative—of the plankton present along the route traversed is well known to all interested in plankton research, and it may well be that the not distant future will see this apparatus installed as part of the regular equipment of vessels engaged in the fishery of those important food-fish—such as herring, pilchard or mackerel—which, subsisting on particular types of plankton, tend naturally to concentrate where their favourite food happens for the time being to be most abundant.

Prof. Hardy, on the whole, supports Sir John Graham Kerr's plea for the appointment of an expert committee to examine into the practicability or otherwise of drawing upon the plankton directly for the reinforcement of the food supply of Great Britain. He emphasizes the nutritive value of plankton. He quotes chemical analyses, which we find perhaps less impressive since an encounter many years ago with a destructive beetle larva which was able to subsist upon a diet of dry cork, and out of it—in apparently complete defiance of all dietetic principles—to build up living protoplasm indistinguishable chemically from that of a human being. But Prof. Hardy tells us too how not long before the outbreak of war, German researchers reported upon two different types of plankton as being respectively equivalent in nutritive value to 'the best meat' and to rye flour. Finally, he quotes the case of the whalebone whales, and, unmindful of the reminder conveyed in a charming leading article in *The Times* regarding their ungainly portliness, the more seriously directs attention to the extraordinarily rapid growth of the young whale as incontrovertible evidence of the nourishing qualities of its food. The practical suggestions made by Prof. Hardy in regard to the large-scale collection of plankton, are, in view of his special knowledge, worthy of attention, and no less so his hint that the preliminary stages in the working out of the plankton-food problems might well be undertaken during the present summer.

Coastal Plankton of New South Wales

PROF. W. J. DAKIN has been working for nine years at the study of plankton off Sydney Harbour. The difficulties were many, but a great deal has been accomplished which acquires a deeper significance when one realizes that it is the preliminary to further fisheries researches in the future. A small yacht only was available, but with this, fortnightly samples of plankton with accompanying hydrographic data (the last only for the first three years) were taken almost continuously. The results, which include much original work not published elsewhere, are now available ("The Plankton of the Australian Coastal Waters off New South Wales. Part 1." Publications of the University of Sydney. Department of Zoology. Monograph No. 1. By William J. Dakin and Alan N. Colefax. 1940). There is, however, much more in it, for it is a general guide to Australian plankton indispensable to all who study the subject in these waters, the introductions give a good survey of each group, and almost every organism is described and, in most cases, figured. Lists of relevant literature are given at the end of each section and certain specialists have helped in identifications. Mr. Takari Tokioka's contribution on the Chætognatha with its beautiful figures is noteworthy. Mr. Alan Colefax is responsible for the large and detailed section on the Copepoda and also for the chemical analyses.

Prof. Dakin is the author of the main part of the work. Among the Crustacea his notes on life-histories are valuable, especially among the Decapods. The larval stages of the Australian Decapods are little

known, and this is obviously an extensive field for research. Larval Thalassinids form a large part of the plankton, especially inshore. "In one quarter-hour haul at Broken Bay in April 1935, there were hundreds of thousands of larvæ in different stages." Gurney, in the "Discovery" Reports (1938), has shown that there are many more Thalassinid larvæ than known adults (especially belonging to the Axiid-Callianassid group). Here again in Sydney Harbour the adults are not known, except in a very few instances. The larvæ occur at certain stated times. It will be interesting to hear of more researches on these forms—a difficult subject, as these Thalassinids live in very inaccessible places, and there must be an enormous number of undescribed species. The present work deals mainly with invertebrates, but there is a small section on fish eggs. Further work on these and on other groups here not fully dealt with are subjects for the future.

War-Time Medicinal Formulæ

THE direction of the policy which is being adopted in the compilation of war-time formulæ for medicinal preparations is indicated by the nature of the recommendations recently made by the British Pharmaceutical Codex Revision Committee. It may well be that there is little need to replace all those drugs now unobtainable by alternative substances. On the other hand, it is very desirable that authoritative guidance should be given to prescribers as to substitutes for at least some of the scarce or unobtainable drugs, and also as to the best combinations in which to present them. This duty falls upon several bodies recognized as being properly constituted for the purpose, and one such is the Codex Revision Committee.

The recommendations made by this body are not restricted to the replacement of scarce substances by those which are more freely available. They cover a wider field. Thus it is proposed to authorize the use of tap water in place of distilled water except in injections and in preparations for which the pharmacist may consider distilled water more suitable. To the patient who invariably uses tap water to dilute his medicines, where dilution is directed, there appears to be nothing remarkable in this recommendation and there would seem to be little reason why it should not continue to be applied in peace-time. With regard to alcohol the Committee, following the advice of the Medical Research Council, that, in order to observe economy in the use of alcohol, many tinctures should be replaced by concentrated preparations, agrees that concentrated liquid extracts should be employed instead of tinctures and has decided to draw up a list of liquid extracts which might be used for this purpose. Other recommendations have their origin in the scarcity of tragacanth, squill, liquid paraffin, olive oil and almond oil.

Food Growing and Utilization

IT is fully recognized that the amateur gardeners and allotment holders of Great Britain are making a vital contribution to the war effort. Maximum crops need to be raised and any wastage through faulty storage or cooking must be avoided. The "Penguin Book of Food Growing, Storing and Cooking", by Mr. F. W. P. Carter, provides much practical information in a simple manner on these subjects (Penguin Special, *S*.90. Harmondsworth: Penguin Books, Ltd. 6*d*.). Crops are dealt with alphabetically which makes reference simple. The method of cultivation, recommended varieties, quantity of seed required, likely pests and their control, storage and where possible also cooking methods are described for all the more commonly grown vegetables. Good general information is also given regarding the preparation of the soil. The booklet concludes with simple suggestions for garden work each month and a detailed cropping plan for a period of three years on a typical allotment.

The correct utilization of food is dealt with by Mr. Frank Wokes in another Penguin Special, "Food: the Deciding Factor" (S. 87. 6*d*. Much information on food values and diet is compressed into a small space. The energy and body-building values of different types of food are explained, and diets suggested which make for properly balanced meals, rationing being taken into account. A considerable part of the booklet is devoted to the question of vitamins, the quantities required and the foods which supply them. Interesting tables are given in the appendix showing the body-building and energy values, mineral and vitamin contents of a large number of generally consumed articles of food, including cereals, dairy produce, fish, fruit, meat and nuts.

Institute of Physics: Industrial Radiology Group

FOR some considerable time, physicists engaged in the various branches of industrial radiology have expressed a wish for some means whereby they could come together for the mutual discussion of their particular problems. Accordingly, the London and Home Counties' Branch of the Institute of Physics arranged a Conference on Industrial Radiography in January 1941 (see NATURE, February 8, p. 183). As a result of this Conference it was decided to ask the Board of the Institute of Physics to approve the formation of a Radiography Group. The Board's approval having been obtained, the inaugural meeting of the Group was held on May 20, at the Social Centre of Messrs. Kodak, Ltd., Harrow, about seventy people attending—some coming from as far afield as Leven, Motherwell, Sheffield and Derby. The title "Industrial Radiology Group" being approved by those present, Dr. L. Mullins, of the Research Laboratory of Messrs. Kodak, Ltd., was appointed honorary secretary, and the following committee was elected: Drs. W. Betteridge, D. W. Davison, and H. Lowery, Messrs. A. N. Gilchrist, W. L. Harper, H. P. Rooksby, H. S. Tasker, D. E. Thomas, and E. J. Tunnicliffe.

So constituted, the present committee is representative of those concerned with the industrial applications of radiography and X-ray crystallography and of those engaged in the manufacture of industrial X-ray apparatus and X-ray films. In addition, the British Institute of Radiology and the

Society of Radiographers are to be asked to send one representative each to serve on the committee. This committee was given power to elect its own chairman and to formulate a constitution for the Group. In addition to providing a medium for the exchange of views and experiences on the practice of radiography and X-ray crystallography in industry, it is to be hoped that the Group may ultimately issue a report summarizing many of the essential practical points of importance to users of X-ray plant, as one noticed at the above-mentioned Conference that many quite elementary matters of technique were not generally known in the various industries employing X-rays. Membership of the Industrial Radiology Group is open to all who are interested, whether or not they are at present members of the Institute of Physics.

Association of Scientific Workers

THE annual council meeting of the Association of Scientific Workers was held in Birmingham on May 24 and 25; eighty delegates were present representing scientific workers and engineers in industrial and Government posts as well as university staff and students. As this was the first council meeting to be held since the registration of the Association as a trade union, the reports presented, and the ensuing discussion, were chiefly concerned with the planning of an industrial policy for the Association. Discussion centred mainly around a report by the Industrial Sub-Committee which analysed the present conditions of scientific and engineering staff. This report showed that even under peace-time conditions, there is a considerable difference between salaries paid to people having the same qualifications but employed by different firms. In the engineering industry, for example, the general salary level is notably less than in certain chemical firms. Increments were often obtained by negotiation between the employer and the individual, but war-time restrictions on change of employment have removed the individual's chief bargaining instrument. A survey among members of the Association shows that there is a marked tendency in industry for no increments to be given, while in Government establishments war-time posts carry a fixed salary.

It was pointed out in the discussion that cancellation of increments is particularly unfair to the younger scientific workers whose salaries are frozen at the low starting figure. Attention was also directed to the injustices caused by failure to grant payment for overtime to many scientific workers and engineers. It was said to be a common experience, particularly in large firms, for hours of work and holidays to be altered suddenly without consultation with the unorganized sections of the staff. The conclusion drawn by the Industrial Sub-committee of the Association and endorsed by the council meeting is that collective action through the Association is the only effective method by which engineers and scientific workers can safeguard their conditions, and bring them into relationship with those of organized sections of industry. The council unanimously adopted a resolution in favour of close co-operation between the Association and other trade unions.

Mummification in America

REFERENCE has already been made (NATURE, April 5, p. 413) to the first part of a description by Dr. Aleš Hrdlička, curator of physical anthropology in the U.S. National Museum, of investigations undertaken in mummy caves and rock shelters in the Aleutian Islands off the coast of Alaska (*Scientific Monthly*, Jan.–Feb. 1941). It would appear that the aboriginal inhabitants were at some unknown period replaced by the Aleuts, among whom, comparatively lately, Russian penetration took place. The Aleuts practised mummifying, though whether they began to do so after their arrival in the islands or whether they brought the custom with them from their unknown place of origin remains a mystery. The mummies of both sexes were stored in the caves lying upon driftwood, and differences of physical anthropology among them suggest that a few members of the pre-Aleut people had been allowed to survive, perhaps in a condition of slavery. The finding of one or two objects of Russian origin with some of the mummies seems to indicate that the practice continued until a fairly recent date. A certain amount of cremation also appears to have been customary, and interesting and well-developed industries showing some degree of artistry were collected. The difficulties under which the expedition worked were very considerable, but nevertheless much valuable information has been added to our knowledge of these interesting peoples.

The practice of mummifying the dead, like that of trephination, is always intriguing. Why should these elaborate processes have been undertaken at all? Connected as they often were with magic or religious notions, their discovery sometimes throws a sidelight on the ideas of bygone peoples; whereas a study of the ordinary industries of such folk only determines their material culture—only tells us how they lived, not how they thought. Actually, mummifying has never been a common method of dealing with the dead either in modern or in ancient times. Egypt, of course, furnishes the classic example, but in the New World there were peoples both in South and North America who practised the rite. The orthodox diffusionist naturally claims that the custom in, say, Peru derived from Egypt; but frankly it is difficult to believe that the two or three prehistoric American peoples really had any connexion either with the Old World or with each other. It would seem far more likely to have been the result of a spontaneous development consequent upon a somewhat similar outlook on death.

Floating Electric Power Plants

MR. A. C. HARDY, in an article entitled "The Electric Ship" in the *Electrician* of May 2, outlines some recent trends and developments. A project for a 50,000 kw. self-contained, floating power plant

is being studied by the General Electric Co., Schenectady. The plant is to be housed in a hull of similar dimensions to that of a Great Lakes freighter capable of passing through the Welland Canal, the dimensions being limited to 290 ft. by 43 ft., with a draught of 10 ft. and a low-bridge clearance of 15 ft. It is recalled that this idea is not new, for two 10,000 kw. turbo-generators were installed in the hull of the *Jacona*, a vessel built during the War of 1914–18, and since 1930 used as a floating power plant in New England. This vessel was taken in hand at the works of the Newport News Shipbuilding and Dry Dock Co. The main engine boilers and auxiliary formerly used for propulsion were removed. The funnel, foremast and four forward winches, propeller, shaft-tunnel and shafting were removed. New watertight bulkheads were installed fore and aft, and special thickening was fitted underneath the power plant. Two steam turbo-generators were installed, taking steam from four marine boilers, delivering 280,000 lb. of steam per hour at 425 lb. pressure at 250° F. superheat. The steam consumption of the turbines is about 9·4 lb. per kwh. at full load, the turbines being directly connected. With the exception of a few auxiliaries, the whole of the plant is divisible into two separate units, two boilers being arranged to serve each turbine. The method of making electrical connexion to the shore is a problem involving considerable study.

James Nasmyth as Tool Maker

WHEN James Nasmyth (1808–1890) was twenty-six years of age he set up in business as an engineer in Manchester, and two years later, at Patricroft on the Bridgewater Canal, he established the famous Bridgewater Foundry, so named after the Great Duke. By 1856, Nasmyth was able to retire and devote himself to astronomy. The foundry, however, was carried on successfully by others until July 1940, when it became a Government ordnance factory. One consequence of this was the presentation to the Institution of Mechanical Engineers, by Sir Holberry Mensforth, of Nasmyth's well-known "Sketch Book" and a portfolio of early drawings. Most of the drawings are of steam hammers, but others relate to machine tools. Some of these are of exceptional interest, and in *The Engineer* of May 23, Dr. H. W. Dickinson gives a review of Nasmyth's pioneering work in this department of engineering. As an appendix to the article a transcription is given of a letter written in 1864, in which Nasmyth refers to his discovery of the 'willow leaf' pattern on the sun's surface, a discovery which "has made a great stir among astronomers".

Activated Charcoals from Peat Residue

IN the tenth part of a series of "Studies in Peat", J. Reilly and J. R. O'Donoghue (*Sci. Proc. Roy. Dublin Soc.*, **22** (N.S.), 367; 1941) report experiments on the preparation of activated charcoals from peat. Before preparing the charcoal, waxy constituents were removed. Of various methods used, activation with superheated steam, and, to a lesser extent, by treatment with syrupy phosphoric acid before carbonization were found to be best for producing charcoals of performance approaching commercial standards. So far as is known, the peat residue is the first substance of Irish origin to be examined as a source of active charcoal.

Earthquakes in Turkey

THAT the earth's crust has not yet settled down after the disastrous Turkish earthquakes of December 1939 is evidenced by recent earthquake activity in that country. Minor shocks are frequently experienced, and stronger ones occur from time to time. Two such happened during the last fortnight. A strong earthquake on May 24 broke the sea wall at Mugla, opposite the island of Rhodes. Some other damage and twenty casualties have been reported at Mugla, and less intense shocks were experienced at Smyrna. During the night of May 30–31, a strong tremor was felt in Anatolia, causing serious damage to a large number of houses. No casualties have been reported as a result of this shock.

Announcements

PROF. L. J. MORDELL, F.R.S., Fielden professor of pure mathematics in the University of Manchester, has been awarded the De Morgan Medal of the London Mathematical Society.

DR. J. A. VENN, president of Queens' College, Cambridge, and Gilbey lecturer in agricultural economics and history, has been elected vice-chancellor of the University for the academical year beginning on October 1, in succession to Mr. E. A. Benians, master of St. John's College, who has held the office for the customary two years.

The Adams Prize for 1939–40, valued at about £268, has been awarded to Dr. Harold Davenport, assistant lecturer in mathematics in the University of Manchester. Dr. Davenport, who graduated as a wrangler, was formerly a fellow of Trinity College.

THE herbarium near Hudiksvall, in Sweden, containing thirty thousand specimens of roses, compiled and classified by the late Reinhold Matsson, the Swedish botanist, has been destroyed by a fire.

A NEW division of chemotherapy has been formed in the National Institute of Health of the United States Public Health Service to be under the direction of Dr. William H. Sebrell, jun. The new unit will be concerned with research on sulphanilamide products and with new synthetic drugs with antimalarial properties, in order to make the United States independent of the Dutch East Indies supply of quinine. The division will have quarters at the National Institute of Health in Bethesda, Maryland. The building will also be the headquarters of the divisions of chemistry and zoology.

ERRATUM. The title of the letter by Dr. H. L. A. Tarr in NATURE of April 5, p. 417, should read "The Bacteriostatic Action of Nitrites"; thus the work relates to "nitrites" and not to "nitrates" as printed.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

Further Correlation of Physical and Biological Properties in an Acridine Series

THE partition coefficients between olive oil and water of the five monoaminoacridines[1] have been investigated, and the results, set out in the accompanying table, include acridine and proflavine (2 : 8-diaminoacridine) for comparison.

The method followed was to dissolve the amine hydrochloride in a large excess of phosphate buffer solution (*p*H 7·0) and to shake this for two hours at 25° C. with sufficient acid-free olive oil[2] to extract approximately half the amine. The emulsion was centrifuged and the aqueous layer compared in a colorimeter with the unextracted solution. The latter was then diluted to the concentration found for the extracted solution, and the two were again compared in order to compensate for any deviation from Beer's Law. Finally where, as in the cases of 3- and 4-aminoacridines, there is a profound change of colour on acidification, both solutions were brought to *p*H 2·5 and again compared. Concordant readings were given by all methods. The concentrations of each amine at equilibrium were arranged to vary in different experiments, the aqueous layer containing 0·5–3·0 mgm. per 100 ml. in regular steps. In spite of this sixfold variation, no change in the coefficient was noted, indicating that association does not take place.

On account of the sparing solubility in water of acridine and 1-aminoacridine, it was necessary to devise a modified technique by reversing Farmer's procedure[3] for calculating the dissociation constant of an amine from its partition coefficient. Accordingly 1-aminoacridine was extracted by oil from its solutions in *N*/100 sulphuric acid and the aqueous layer (*p*H 2·1) compared with unextracted solution brought to the same *p*H value. The amount of amine in the oil was found by subtraction and was divided by the amount of free base existing in the aqueous layer at equilibrium as found from the equation :

$$\log \frac{[B]}{[BH]} = p\mathrm{H} - 14 - \log K \quad . \quad . \quad . \quad (i)$$

which is derived from $\frac{[B][H]}{[BH]} = \frac{10^{-14}}{K}$,

$[B]$ and $[BH]$ representing concentrations of free base and its salt respectively.

Since salt-formation has been taken into consideration, partition coefficients calculated as above are comparable[3] with those found at *p*H 7, at which value 1-aminoacridine and acridine are almost entirely hydrolysed. Acridine, being almost colourless, was estimated by precipitation with excess picrolonic acid, filtration through fritted glass, and titration of the uncombined picrolonic acid with methylene blue[4].

It will be seen from the table that there is a correlation of physical and biological properties in this series in so far as the members most active against bacteria are the most basic and the most hydrophilic,

	Partition coefficient oil/water	Dissociation constant, water, 25° C. $\times 10^{-10}$	Bacteriostatic index[1]. (Sum total of inhibitory dilutions)	Average lethal dose (mouse)	Bactericidal value[5]
				gm./kgm.	
5-Aminoacridine	1	300,000	43	0·08	96
Proflavine	0·5	120,000	41	0·14	92
2-Aminoacridine	5	12,000	41	0·17	82
4-Aminoacridine	55	30	17	0·33	61
3-Aminoacridine	90	12	17	0·33	56
Acridine	250	2	12	0·30	Not tried
1-Aminoacridine	1200	1	8	0·91	49

whereas the least basic and most hydrophobic members have only feeble antiseptic properties.

The bacteriostatic index is quoted from a previous communication[1]. The average lethal dose (*L.D.* 50) was found by subcutaneous injection of mice using 6–12 mice for each dose and interpolating for a 50 per cent kill after plotting the logarithm of each dose against the percentage killed. It will be noted that the mammalian toxicity rises with the bacteriostatic index, but as the latter figure represents powers of 2, it can be shown that the mammalian toxicity does not tend to rise on so steep a gradient as the toxicity to bacteria. The bactericidal values quoted in the table represent the percentage reduction of hæmolytic streptococci effected by a 1 : 10,000 concentration of the derivative in 10 per cent serum broth after two hours at 37° C.

The causes underlying the correlations are not yet clear. The hydrophilic properties of the strong bases are not due to the fact that they exist mainly as salts at *p*H 7. For example, 5-aminoacridine, which at *p*H 7 contains only 0·3 per cent of free base (from equation (1)), has its partition coefficient of 1 raised only to 3 at *p*H 10 where it contains 80 per cent of free base. Moreover the biological properties may be found to depend not so much on the basicity as on the various types[1] of amino groups which the basicities indicate.

The biological results quoted in this paper will appear elsewhere in greater detail[5]. Meanwhile 5-aminoacridine is undergoing clinical trial as a non-staining antiseptic with the general properties of proflavine.

ADRIEN ALBERT.

Department of Organic and Applied Chemistry, University of Sydney.

REGINALD GOLDACRE.

Department of Agriculture, New South Wales.

SYDNEY D. RUBBO.

Department of Bacteriology, University of Melbourne.

[1] Albert, A., Rubbo, S. D., and Goldacre, R., NATURE, **147**, 332 (1941).
[2] Anon., *Pharmaceut. J.*, **132**, 635 (1934).
[3] Farmer, F. J., *J. Chem. Soc.*, **79**, 863 (1901); Farmer, R. C., and Warth, F. J., *ibid.*, **85**, 1713 (1904).
[4] Bolliger, A., *Analyst*, **64**, 416 (1939).
[5] Rubbo, S. D., Albert, A., and Maxwell, M. (in preparation).

'Crossed Fibrillar' Structure of Plant Cell Walls

THE so-called 'crossed fibrillar' structure observed in the walls of some plant cells[1,2,3] and inferred in a variety of others[4] still awaits explanation, and although the evidence for its presence in the latter cases can scarcely be considered satisfactory[5], this type of structure is sufficiently widespread to present a problem of the first magnitude in cell-wall physics. Several attempts have been made in these columns and elsewhere to define the underlying mechanism, and it is the purpose of this note to point out a new possibility which arises from the recent work of Astbury and Bell[6]. The importance of the organization of the protoplasmic surface in considerations of wall structure is now slowly being realized, and recent evidence[1] suggests that it is in this surface that we are to seek the mechanism involved in the regular alternation of chain orientation implied by the crossed fibrillar structure. Now in the recent emendation put forward by Astbury and Bell of what may be called the 'classical' model of protein structure, the fibrous proteins keratin and myosin are considered always to be *effectively* in the β-configuration whatever the state of folding [see Figs. 1, 2 and 3, p. 698 of this issue for diagrams of the α- and β-configurations; the supercontracted form would resemble the diagram given by Astbury and Bell for the globular proteins]. The contraction of the α- or of the β- form to the supercontracted condition now corresponds in this model to an effective rotation of the constituent protein chains to the transverse direction.

This type of folding surely gives expression to an underlying principle common to all proteins, including those in the cytoplasm-wall interface, and if we adopt the assumption now being formulated vaguely by some workers that the cellulose chains in a new layer may be oriented in a direction governed by the underlying protein chains, we have a ready solution of the present problem. The direction of cellulose chains may be alternated simply by alternate extension and contraction of the protein chain molecules in the protoplasmic surface. Confirmation of this idea will naturally not be easy. No single cell type has yet been worked out in sufficient detail, but evidence derived from a number of sources is already suggestive.

There are reported in the literature a few cases in which the cellulose chains of the primary wall in an elongated cell lie almost transversely and in later walls layers almost longitudinally[3]. Together with this we may put also the various observations that the physical properties of the cytoplasm in meristematic cells are often different from those in cells becoming adult. We have, for example, numerous statements that high metabolic activity is associated with low cytoplasmic viscosity[7], with one specific observation that in the hyphæ of Rhizopus (the wall of which is of chitin with a structure closely resembling that of cellulose) the viscosity in the growth zone is much less than elsewhere[8]. Changes in viscosity may, of course, be due to any one of a number of causes, but we do know that in some cases a change in fluidity is associated with changes in the configuration of a protein, for example, with contraction of muscle[9], and they are precisely what we should expect if, on passing from the meristematic to the adult state, the proteins in the surface are extending. Similarly we have some grounds for thinking that the *p*H of cytoplasm in a meristem may not be far removed from the isoelectric point of its constituent proteins[10], whereas in adult cells it lies near the point of neutrality. It is well known that proteins are *p*H sensitive and that in some cases *p*H change, though not the causative factor, is associated with muscular contraction[9].

The contraction and extension of the protein chains is naturally to be considered as occurring, or at least being initiated, locally; it has no effect on the external appearance of the cell, the shape of which continues to be controlled by the surrounding cellulose envelope. It is difficult to be precise at this stage, particularly with cells like Valonia, Chætomorpha and Cladophora, where the crossed fibrillar structure manifests itself most markedly. It may be significant that changes in cytoplasmic viscosity often accompany nuclear division.

R. D. PRESTON.

Department of Botany,
University of Leeds.
May 1.

[1] Astbury and Preston, *Proc. Roy. Soc.*, B, **129**, 54 (1940).
Preston and Astbury, *Proc. Roy. Soc.*, B, **122**, 76 (1937); Nicolai and Frey-Wyssling, *Protoplasma*, **30**, 403 (1938); Preston, *Ann. Bot.*, (*N.S.*) **3**, 507 (1939).
[2] van Iterson, *Protoplasma*, **27**, 190 (1937); Anderson and Kerr, *Ind. Eng. Chem.*, **30**, 48 (1938).
[3] Freudenberg and Durr, "Kleins Handbuch der Pflanzenanalyse", **3**, 142 (1932); Bailey and Kerr, *J. Arnold Arbor.*, **16**, 273 (1935).
[4] Preston, *Proc. Leeds Phil. Soc.*, **3**, 546 (1939); *Biol. Rev.*, 14, 281 (1939).
[5] Astbury and Bell, NATURE [p. 696 of this issue].
[6] Frey-Wyssling, "Submik. Morphol. des Protoplasmas und seiner Derivate" (Berlin, 1938); Guillermond, "Traité de Cytologie végétale" (1933); Seifriz, "Protoplasm" (New York and London, 1936).
[7] Guillermond, *loc. cit.*[5].
[8] Frey-Wyssling, *loc. cit.*[5].
[9] Pearsall and Priestley, *New Phyt.*, **22-3**, 185 (1923).

Chemical Substitutes for Dietary Protein

THE stimulating article by Dr. Benesch on the utilization of non-protein nitrogenous compounds as protein substitutes which was recently published in NATURE[1] is a timely contribution to an important subject. At the outset, Dr. Benesch explains that his object in writing the article is to show that "the problem has reached a practical stage". This opinion is, however, by no means shared by all those who have studied the voluminous literature on the subject published (mainly from the Continent) during the past twenty years. In fact the attitude of Krebs, who reviewed the subject exhaustively in 1937, is in many respects diametrically opposed to that of Dr. Benesch. Moreover, it is all too frequently found that the same set of results is accorded entirely opposite interpretations according to the particular outlook of the workers concerned.

In view of this conflict of opinion, and having in mind the probable war-time shortage of feeding-stuffs, a group of research workers at the Hannah Institute began, about two years ago, a series of experiments designed to reinvestigate the value of urea and ammonium salts as protein substitutes for milk production. An endeavour was made to plan the details of the experiments with sufficient care to ensure that the final results would not readily lend themselves to alternative interpretations, due to the inclusion of inadequate controls or to the recording of incomplete experimental data.

The programme of work finally adopted was twofold. In the first section of the work lactating cows

were fed on a diet which was just adequate according to present accepted feeding-standards and which contained a protein of first-class biological value for milk production. This was compared with the same diet in which one third of the protein of the production ration was replaced by urea. Milk yields, body weights, nitrogen balances, creatine-creatinine excretion, milk composition and the partition of nitrogen in the blood were all studied.

In the second section of the work, use was made of a steer with a large rumen fistula to determine, both by *in vivo* and *in vitro* methods, whether protein synthesis could actually be observed in the rumen contents, and, if so, what were the major factors affecting the magnitude and efficiency of such synthesis. In this work the research group was able to secure the valuable co-operation of Mr. Frank Baker of Guildford, who for some years has devoted much time to the study of the microflora and fauna of the rumen and cæcum of Herbivora.

It is hoped that the detailed results of much of the work will be available for publication within the next few months. The two most important findings may meantime be stated tentatively and briefly as follows: (1) Urea, which was first rapidly converted into ammonium salts in the rumen, proved to be of unquestionable value as a partial substitute for protein in the feeding of dairy cattle, *provided that it was fed in proper amounts and in a suitable mixture.* It was readily eaten by the animals and was without ill effects either on their general health or on the yield and quality of their milk. (2) In the course of *in vitro* incubations of rumen contents in which the general conditions of the medium and the microbiological picture (so far as it could be judged) were similar to those in the intact rumen, the conversion of non-protein nitrogen to protein was clearly demonstrable. This conversion, though small, was sufficient to account for the effective utilization of much more urea than would normally be included in the diet of the lactating cow.

The views expressed by Dr. Benesch on this subject, at least in so far as milk production is concerned, appear, therefore, to be fully supported by the present work. Moreover, it is pertinent to note that in the course of the investigation some of the excellent suggestions which he makes for future work have already been put into practice.

E. C. Owen.
J. A. B. Smith.
N. C. Wright.

The Hannah Dairy Research Institute,
Kirkhill, Ayr.

[1] NATURE, **147**, 531 (1941).

"Vegetables as Food"

In a recent article in NATURE[1], it is stated that there is less carotene (provitamin A) in carrots than in spinach, watercress or broccoli. It would be dangerous to allow this statement to pass unchallenged. In reality, as was pointed out in a recent review in these columns[2], the carrot stands pre-eminent as a source of provitamin A. It is the only common foodstuff in Great Britain continuously available throughout the year, a single daily helping of which will supply the full requirement for vitamin A. It is unfortunate, therefore, that doubt should have been cast on this unique virtue of the carrot.

We have made many estimations in this Laboratory and rarely find a carrot having less than 18,000 I.U. per 100 gm. The usual value is more than 20,000, and values up to 38,000 have been obtained. Several varieties have been tested, the sizes varying from 10 to 1,250 gm. While leafy vegetables may be much superior to the carrot in respect of iron and water-soluble vitamins, few of them approach it in carotene content. For example, we find watercress has 2,500–5,000 I.U. per 100 gm., Brussels sprouts 200–600; common cress 1,500.

A possible explanation of the low value given by Dr. Pyke for carrots is that it has been taken from the published comprehensive Tables of Vitamin Values. Considerable discrimination is needed in the use of these compilations. Some of the entries for a given food are of little value compared with others, either because they are based on less accurate work, or because they represent single values rather than ranges of variations. Sometimes differences between species and varieties or the effects of other variables (for example, season, degree of ripeness, etc.) are overlooked. In the determinations on carrots we find that low results are obtained unless precautions are taken to ensure complete extraction and to avoid destruction of the carotene. The range of values for carrot given in Fixsen and Roscoe's tables[3], namely, 3,300–22,000 I.U. per 100 g., places the maximum where in our experience the mean should be. Unfortunately this range, or a mean obtained from it, is copied into other tables and books. The only common green vegetable quoted in these tables which even approaches these values is spinach (4,400–11,000).

We feel also that Dr. Pyke exaggerates when he makes an allusion, divorced from its context, to cooked cabbage as having only 17 per cent of the vitamin C of the fresh cabbage. Workers who have had most experience on the effects of cooking and processing would agree that under average household conditions a more usual loss would be of the order of about 40–50 per cent. With improved methods of cooking (such as boiling in a minimum of water for a minimum time, or by modified casserole cooking), the loss may be so low as 20 per cent.

V. H. Booth.
L. W. Mapson.
T. Moore.

Nutritional Laboratory,
Cambridge.

[1] Pyke, M., NATURE, **147**, 513 (1941).
[2] NATURE, **147**, 132 (1941).
[3] Fixsen, M. A. B., and Roscoe, M. H., *Nutrit. Abstr. Rev.*, **9**, 795 (1940).

In NATURE of April 26 a comprehensive report is given of the meeting of the Nutrition Panel of the Society of Chemical Industry on "Vegetables as Food".

It is unfortunate that some of the facts on vitamin C given in our individual papers have been, in our opinion, misrepresented in this report, so that a false impression is given of the antiscorbutic value of cooked and canned vegetables. Some form of heat treatment is essential for the palatability of most vegetables. It is true that during such treatment a loss of vitamin C occurs, but to refer to "the devastating effect of cooking on the vitamin C in vegetables" and "the loss of the bulk of vitamin C" in the blanching process of canning, is to strain this fact out of its true perspective.

As we emphasized in our communications at the meeting, cooked and canned vegetables have, during this winter, been the main source of vitamin C for the majority of people in Great Britain. In addition

we showed that normal portions of such vegetables, if properly chosen and handled by the housewife, can adequately supply the full daily requirement of the vitamin.

We would emphasize these points in view of the economic importance of heated vegetables under existing conditions.

MAMIE OLLIVER.

Chivers Laboratories,
Histon, Cambridge.

W. B. ADAM.

University of Bristol Research Station,
Campden, Glos.

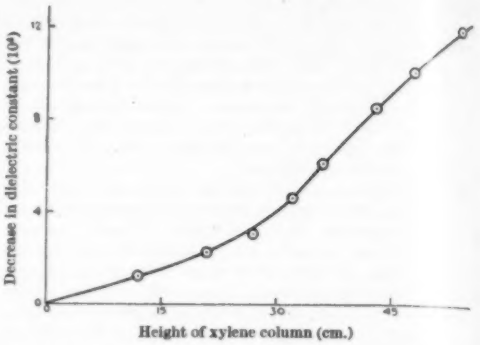
Effect of Flow on the Dielectric Constant of Liquids

WE have observed that certain liquids, for example, xylene (a mixture of *ortho-*, *para-* and *meta-*), ethyl ether, ethyl alcohol and benzene show very small yet distinct decreases in the values of their dielectric constants when they are flowing through condenser plates of small separations. With a given separation the amount of change is found to increase with the rate of flow of the liquid. A typical graph showing the variations in the dielectric constant of a freshly distilled sample of xylene (a mixture of *ortho-*, *para-* and *meta-*) with flow under the pressure of different heights of the liquid is given in the accompanying graph. The temperature of the xylene remained practically constant at 24·0° C. throughout the experiment.

All the measurements for the dielectric constant were made by the usual heterodyne beat method using a wave-length of 300 metres. The experimental condenser consists of two horizontal circular brass plates; the lower one forms the main body of the apparatus, and the upper is separated from it by small, thin pieces of mica (thickness of the order of 0·01–0·02 cm.). The lower plate is provided with an opening at the centre which is connected by means of a U-tube to a long vertical glass tube of internal diameter 2·4 cm. The U-tube is fitted with a stopper. The upper plate is of diameter 8·6 cm. and of thickness 0·6 cm. and is fitted with a vertical rod at the centre. A load of about 10 kgm. is kept above the disk to prevent any mechanical displacement of the disk due to the hydrostatic pressure or flow of the liquids.

The condenser, the connecting tube and the vertical glass tube are filled with the liquid, and the flow of the latter commences as soon as the stopper is opened. The liquid rises through the central opening of the lower plate and after passing through the narrow space between the plates of the condenser comes out and is collected in a receiver. The level of the liquid in the vertical glass tube is kept constant by feeding the liquid at an adjusted rate from above. The changes in the capacity of the experimental condenser during flow are measured with the help of a specially designed condenser used by one of us[1] in the measurement of the dielectric constant of an electron atmosphere. With this condenser changes so small as 0·004 $\mu\mu$F. can be measured.

Precautions were taken to see that changes observed in the capacity during the flow of the liquid were not due to any spurious effect such as mechanical displacement of disk or similar stray capacity changes. The entire experimental arrangement is enclosed in a case lined with tin which is connected to the earth; all adjustments are made from outside.



Changes in the dielectric constant during flow are observed in polar as well as in non-polar liquids. But a more viscous liquid like amyl alcohol is found to show the effect to a much smaller degree. Observations with liquid heights greater than that shown in the graph could not be taken due to certain practical difficulties. Further investigations are, however, in progress and a detailed report will be published elsewhere.

We are grateful to Principal K. Prosad for the keen interest he has taken in this work.

S. P. PRASAD.
B. N. SINGH.
B. D. SINGH.

Physics Laboratory,
Science College,
Patna.
Feb. 24.

[1] Prasad, S. P., and Varma, M. N., *Z. Phys.*, **99**, 552 (1936).

Kinetic Friction Coefficient

THE ordinary static friction apparatus with one mass m hanging over a pulley and connected to another mass M resting on the friction board may be used to determine the kinetic coefficient. Let m be more than sufficient just to move M, and let h be the vertical height over which m is allowed to accelerate M; then, if x is the extra distance along the board traversed by M before it is brought to rest by friction, the average coefficient is given by:

$$\mu_k = \frac{m}{M + (M + m)\frac{x}{h}}$$

By varying m in order to get a range of speed, the following fairly consistent values were got:

M (gm.)	m (gm.)	Coefficient of kinetic friction
74·4	42·7	0·33
74·4	52·7	0·33
74·4	62·7	0·32
74·4	72·7	0·33
74·4	82·7	0·36
74·4	92·7	0·32
74·4	102·7	0·32
74·4	112·7	0·33
74·4	122·7	0·33

It may be that the method is in use, but a search in our selection of books on practical physics has not disclosed it.

SIDNEY RUSS.

Barnato Joel Laboratories,
The Middlesex Hospital,
London, W.1.

RESEARCH ITEMS

Ptinid Beetles of Economic Importance

In the *Bulletin of Entomological Research* (**31**, 331–381; 1941), H. E. Hinton, of the British Museum (Natural History), contributes a critical revision of 21 species of the family Ptinidæ that have been recorded as pests. The object of this work is to illustrate and describe these species in sufficient detail in order to facilitate their ready and accurate identification. In general, these beetles are known to infest an enormously wide range of stored products, and occur in houses, drug stores, warehouses and granaries. Some species have been found in association with such apparently unpromising substances as cayenne pepper, opium, argol and indiarubber. Others have been found in grain, nests of bees, in fish meal, cacao, in insect collections, birds' nests, etc. Three British species of Ptinus are of no economic importance, but have been included so as to make the paper applicable to all the British Ptinidæ. Six of the species of this family have not so far been found in Britain. It is interesting to note that several of the species have been known since the end of the eighteenth century, while *Ptinus fur* was described by Linnæus as *Cerambyx fur* in the "Systema Naturæ" (1758).

Chiasma Interference

H. B. Newcombe (*Genetics*, **26**, 128–137; 1941) has shown that coincidence values obtained from the direct observation of the position of chiasmata in *Trillium erectum* correspond with those of genetical analysis of cross-overs. Interference in an arm of a chromosome may still be present in a distance of 2 microns; above this distance the coincidence value does not differ from unity. Across the attachment constriction the value is significantly greater than unity. An increase in chiasma frequency is accompanied by decreased coincidence across the centromere and increased coincidence within an arm.

Inert Chromosomes

C. D. Darlington and M. B. Upcott (*J. Gen.*, **41**, 275–297; 1941), have examined the behaviour of the *B* or supernumerary chromosomes of maize. These chromosomes are heterochromatic and have an excessive nucleic acid charge. Their chiasma frequency is less than proportionate to their length on the *A* chromosome standard. Since these *B* chromosomes may be reduplicated, it can be shown that the crossing-over frequency is increased with odd numbers of chromosomes; this is due to the potential increase in change of pairing partners. *B* chromosomes are irregular in behaviour during mitosis and meiosis and may be lost or give rise to chromosomes with deletions. On the other hand, lines of maize show a constant number of *B* chromosomes. Therefore, there would appear to be a selection pressure favouring *B* chromosomes. Thus the inert chromosomes would appear to be active in some physiological sense.

Sexuality in Wild Populations

The occurrence of peculiar sex forms in species of plants has been a puzzle to many workers. In contrast to pure diœcism in higher animals, sex intergrades occur irregularly among plant species which are predominantly hermaphrodite. D. Lewis (*New Phyt.*, **40**, 56; 1941) has shown that male-sterility of hermaphrodites due to cytoplasmic causes has more chance of survival than that due to genic male-sterility. With genic male sterility the frequency of 'females' in a population is 50 per cent and in no case can an equilibrium between 'females' and 'hermaphrodites' be reached unless the females are initially twice as fertile as hermaphrodites. On the other hand, cytoplasmic male-sterility can produce 100 per cent 'females'. If the 'females' have only a slight advantage over the hermaphrodites they will spread in the population. This advantage may be one of compulsory outbreeding, thus giving rise to hybrid offspring. Cytoplasmic sterility, therefore, is sensitive to several selective agencies in the wild population.

North Pacific Earthquake of November 10, 1938

An important investigation is at present being made by K. E. Bullen and J. F. de Lisle on Rayleigh waves from the North Pacific earthquake of November 10, 1938. On account of the importance of this earthquake in the problem of Pacific crustal structure due to the unusually large and clear surface waves, J. F. de Lisle has estimated the degree of accuracy of the epicentre and origin-time used (Wellington, New Zealand: Dominion Observatory Bull. No. *S*-58; 1941). To do this a careful investigation was made of the *P* residuals, taking into account the ellipticity corrections. The author has shown by this work that the epicentre as assumed by the Jesuit Seismological Association, namely, 55·6° N., 157·7° W. is subject to an uncertainty probably not exceeding 0·3° in an east–west and 0·1° in a north–south direction, while the origin time of 20h. 18m. 48s. G.M.T. probably needs a correction of − 3 seconds.

A Closed Dyke-Sill Intrusion in the Transvaal

An intrusion of altered quartz-dolerite of unique form, occurring in Marievale Mine and adjoining mines on the Far East Rand, is described by J. Ellis (*Trans. Geol. Soc. Africa*, **43**, 127–142; 1941). The shape of the intrusion is that of a stepped dome of alternating dyke and sill phases. The intrusion, known in the mines as the 'Old Lady', never reached the surface, the top being of sill-like form below the Kimberley Shale. Against the inside of the dyke phases the strata are vertically displaced, the downthrow being equal to the thickness of the sill phase and generally of the order 150–200 ft. The dyke phases form closed rings at the levels where they occur, and there has been little or no horizontal separation of the strata. The mechanics of the intrusion are discussed in considerable detail. It is

shown that the formations above the sill phases were not uplifted, but that subsidence of the rocks enclosed within the intrusion took place. The cause of subsidence, which cannot have been very deep-seated, is sought in the Basement Complex. It is suggested that the latter was weakened or melted by the rise of basic magma, and it is thought possible that the quartz-dolerite may be the result of contamination by granite of a parental basaltic magma. Evidence is presented that the age of the intrusion is just before or just after that of the Ventersdorp lavas which, petrochemically, are of similar type. Owing to the unusual shape, the reef displacement, and the toughness of the rock, the 'Old Lady' is everywhere a considerable source of embarrassment in mining operations.

Age of the Monchiquite Dykes of Colonsay

Two monchiquite dykes occurring in Colonsay belong to a suite of monchiquite and camptonite dykes, commonly following a north-west trend, of which members have been found in Coll, Iona, Mull and various parts of the mainland of Argyll. Although on grounds of petrographic analogy these are all thought to be of the same age, their geological relations nowhere provide direct evidence of what that age may be. The ages of the Colonsay examples have now been determined by the helium method by W. D. Urry, and for comparative purposes the ages of two Carboniferous basic rocks from Shropshire have also been measured. Petrological, chemical and other details of the rocks are provided by A. Holmes, who supplied the specimens, and the results are published in a joint paper (*Geol. Mag.*, **78**, 45; 1941). Arising in part out of this investigation, it was found in 1937 that many of the helium ratios on which the 'helium' time-scale had been based were too high, because of a previously unsuspected error in radium determinations due to reliance having been placed on a radium standard which was seriously at fault. The new results, together with a few others, are given in the following table, which forms the nucleus of a revised 'helium' scale.

Geological age	*Rock type and locality*	*Age in millions of years, of the helium scale*
Pliocene	Basalt, Oregon (1)	8
Miocene	Basalts, Washington (3)	10
Oligocene	Basalts, Silesia (3)	20
Cretaceous–Jurassic	Granodiorites, California (5)	60
Triassic	Dolerites and basalts, New Jersey—Nova Scotia (3)	93–105
	Monchiquite, Colonsay (4)	125
	Biotite-monchiquite, Colonsay (4)	130
Upper Carboniferous	Dolerite, Clee Hills, Shropshire (1)	135
Lower Carboniferous	Basalt, Little Wenlock, Shropshire (1)	140
Devonian	'Newbury Volcanic Rock', Massachusetts (1)	180

The Colonsay results fall between those for the Triassic and the Carboniferous. It is therefore concluded that the Colonsay monchiquites are of late Carboniferous or Permian age, with considerable probability in favour of the latter. It should be noticed that although the 'helium' time-scale is internally consistent, the 'ages' therein are much lower than those given by the 'lead' method. The reason for this discrepancy is not yet known, and several investigators are collaborating in the attempt to elucidate it.

Variability of Rainfall in New Zealand

WHEN considering the suitability of a climate for most agricultural purposes it is necessary to know not only the average rainfall but also its variability. It is doubtless this fact which has led to the publication of *Meteorological Office Note* No. 24 of the Air Department, New Zealand, by C. J. Seelye, entitled "Variability of Annual Rainfall in New Zealand". Since the annual rainfall only is dealt with, the variability can be shown in a single map which brings out clearly the main features of its geographical distribution, variability being expressed by the average percentage variation from the mean for a selected period, in this case 1901–35. In New Zealand, low variability results when the fall comes largely from persistent westerly winds, while the rainfall derived mainly from easterly winds and from tropical cyclones shows high variability. For these reasons, areas with more than 18 per cent variability are found only in the north, and those with less than 8 per cent only in the extreme south, while the east on the whole is more variable than the west. The extremes are 8·7 at Queenstown and 21·2 at Petane, to the north of Napier. New Zealand is slightly less fortunate than the British Isles, where variability ranges from about 6 to 17 per cent only, with an average of roughly 11 per cent, but is far more fortunate than many countries bordering the tropics, for example, Arabia and Egypt, where variability exceeds 50 per cent. Nevertheless, in individual years single stations in New Zealand sometimes show departures from the average that must be very disturbing from the point of view of agriculture, the district including Nelson and Marlborough providing extremes of only 44 per cent in 1915 and as much as 232 per cent in 1936; in Southland, on the other hand, the corresponding extremes are only 63 (in 1907) and 153 per cent (in 1913).

Harmonic Analysis of Barometric Pressure

THE harmonic analysis of barometric pressure has been greatly extended geographically in recent years, and the latest addition comes from the Meteorological Office of New Zealand. In *Meteorological Office Note* No. 23 of the Air Department, New Zealand, C. J. Seelye discusses the variations at Wellington, New Zealand, for the period July 1914 to December 1938, during which time a Short and Mason barograph was in operation, at first at a height of 16 ft. above mean sea-level, but after September 1930 at a height of 425 ft. The indications of the barograph were corrected by means of mercurial barometer readings at 9 a.m. N.Z.M.T., supplemented after September 1930 by additional readings at 11.30 a.m. and 3 p.m. N.Z.M.T. Monthly values of the amplitude and phase angle for the 24-hr., 12-hr., 8-hr. and 6-hr. terms are discussed in detail. Of these, the second is, of course, the largest, the amplitude varying from 0·49 millibars in November (early summer) to 0·40 mb. in June. It is on an average for the whole year roughly three times as large as the amplitude of the 24-hr. term. The existence of one annual minimum value of the amplitude of the 12-hr. term had been noted at eight other stations in the southern hemisphere by Kochanski, who observed that the normal rule is for maxima to occur at the equinoxes and minima at the solstices. The 8-hr. term has very regular characteristics, although much smaller than the two already described; it reaches a maximum in January and July, and almost disappears in March

and October. An item of practical importance in weather forecasting, which is included in this study of pressure variation, is a table showing the mean barometric 'tendency' (that is, change in tenths of a millibar in 3 hr.) for different hours of the day, a quantity which when subtracted from the observed tendency leaves the portion which may be attributed to the movement or development of anticyclones or depressions.

Distribution of Electricity in Thunderclouds

OBSERVATIONS made on thunderstorms at Kew Observatory during 1937–39 are reported in detail by Sir George Simpson and G. D. Robinson (*Proc. Roy. Soc.*, A, **177**, 281; 1941). In every thundercloud there is a positive charge of electricity near the top of the cloud, where the temperature is below − 10° C., and a negative charge below the upper positive charge. The generation and separation of these charges occurs in the ice region, and the most probable cause is the collision of ice crystals in the turbulent air associated with the strong ascending currents in a thunderstorm. The collisions charge the ice negatively and the air positively, and it is the settling of the ice crystals relatively to the air which separates the positive and negative charges. Below the main negative charge in the lower half of the cloud there are in most, if not in all, thunderstorm, regions containing positive charges. With few exceptions the temperature where these positive charges occur is above the freezing-point. These low positive charges are associated with heavy rain and they are probably generated by the breaking of raindrops in ascending currents of air.

Ferric Thiocyanate

THE blood-red colour formed from ferric salts and thiocyanates in solution, usually attributed to ferric thiocyanate $Fe(CNS)_3$ (which is soluble in ether) has been regarded by Schlesinger and Van Valkenburgh (*J. Amer. Chem. Soc.*, **53**, 1212; 1931) as due to a complex anion $Fe(CNS)_4'''$, and this view has found its way into the literature. H. E. Bent and C. L French (*J. Amer. Chem. Soc.*, **63**, 568; 1941) have made a new investigation of the matter by a method in which the dependence of the molecular extinction coefficient of the solution on the concentration of ferric and thiocyanate ions at constant *p*H and ionic strength is measured, and they find no evidence for the existence of an ion $Fe(CNS)_4'''$. The supposed migration of the coloured ion towards the anode could not be confirmed; there was only a slight movement towards the cathode. The conclusion is reached that the coloured substance is a cation, $FeCNS''$, but more work is obviously necessary before the old view that it is undissociated ferric thiocyanate is definitely rejected.

Electrical Properties of Solids

THE properties over a wide temperature range have been determined by R. M. Fuoss for a number of polar polymers, such as polyvinyl chloride, subjected to alternating current at 60–10,000 cycles (*J. Amer. Chem. Soc.*, **63**, 369, 378, 385; 1941), the work extending also to mixtures. Characteristic maxima in absorption and dispersion in dielectric constant were found which are interpreted as determined by the size and strength of the polar group, by the length and flexibility of the bond of the polar group to the polymer chain, and by the nature and amount of a second component present as a plasticizer. The fundamental mechanism of alternating field response, it is concluded, is dipole rotation in a medium of high viscosity, the primary effect of temperature being to change this internal viscosity. A transition temperature is described as relating to a process of internal melting. For mixtures, the loss factor for a given frequency and temperature passes through a maximum at a concentration which is characteristic of a given plasticizer. The electrical properties are markedly non-linear in composition in the low concentration range. A method of calculating the distribution of relaxation times from the loss factor — frequency curve is given, and for systems containing polyvinyl chloride an approximate equation is given for these curves. The C–Cl moment in polyvinyl chloride is calculated as 2·0. The theory is in agreement with previous empirical conclusions concerning chain interaction in polymeric systems.

Molecular Anisotropy of Urea and Related Compounds

A CONSIDERABLE amount of data on the magnetic and optical properties of urea and related substances has been correlated in a paper by K. Lonsdale (*Proc. Roy. Soc.*, A, **177**, 272; 1941). From comparisons of the magnetic anisotropy of urea with that of the carbonate and nitrate groups it appears that the hydrogen bonds contribute little to the anisotropy. The anisotropy of the refractivities is greater in urea than in the carbonate group. Urea nitrate, urea oxalate, cyanuric acid dihydrate and anhydrous cyanuric acid all crystallize in larger structures, as shown by cleavage, X-ray, magnetic and optical data. Although the molecules in each layer are joined together by hydrogen bonds, the links between successive layers may not be hydrogen bonds since the layer to layer distance of $3{\cdot}05 \pm 0{\cdot}10$ A. is characteristic even of cyanuric triazide, which contains no hydrogen bonds.

Comet Cunningham, 1940 *c*.

IT is reported from the McDonald Observatory, Texas (*Harvard Announcement Card*, **556**; Jan. 8, 1941) that spectrograms of Comet Cunningham show near 3360 and 3090 A. two prominent groups of lines not hitherto observed in cometary spectra. The first group consists of seven lines of the (0, 0) and (1, 1) bands of the $^3\Pi \rightarrow {}^3\Sigma$ system of NH. The second, also comprising seven sharp lines, arises from the (0, 0) transition of the $^2\Sigma \rightarrow {}^2\Pi$ system of OH. Other ultra-violet lines on the same spectrograms are attributed, though with less certainty, to CH and CN. The identification of NH and OH adds two more molecules to the five previously recognized in comets: CN, C_2, CH, CO^+ and N_2^+. As with these latter, the observed lines of the newly discovered molecules arise from resonance transitions, and the current theory of resonance excitation is adequate to account for their presence. In the visual region, the *D* lines of sodium appeared faintly in emission at the end of December and strengthened rapidly in early January. This, too, is to be expected since the comet made its closest approach to the sun in mid-January. A series of excellent direct photographs of the comet appearing in the *Telescope* of Jan.–Feb., 1941, traces its development from discovery in September 1940 to the end of the year.

DEFICIENCY OF WHITE FLOUR IN RIBOFLAVIN

(Tested with the Flour Beetle *Tribolium confusum*)

BY DR. G. FRAENKEL AND M. BLEWETT,

DEPARTMENT OF ZOOLOGY AND APPLIED ENTOMOLOGY, IMPERIAL COLLEGE, LONDON

THE experiments described here were suggested by the decision of the Ministry of Food to "fortify" white flour by the addition of vitamin B_1 and salts, and by the criticism raised against this proposal (for example, Chick 1940[1], Willcox 1941[2]).

It is to-day general knowledge that highly milled white flour, as compared with wholemeal flour, is deficient in vitamins of the B group and salts and also contains less fat-soluble substances and protein. To use an insect as test animal for vitamins is no novelty, although this method has hitherto been little used. The flour beetle, *Tribolium confusum*, particularly has several times proved to be a very satisfactory test animal owing to its small size, its short life-cycle and its ability to grow normally on substances with a water content of only 10–15 per cent[3–9]. In testing for nutritional deficiencies in flour it is a particularly favourable experimental subject, since flour is its natural food and no other food is required.

If the environmental factors of humidity and temperature are kept constant and at a favourable level, for example, in the experiments described here at 25° C. and 70 per cent humidity (corresponding to a water content of about 14 per cent), the speed of growth is optimal on wholemeal flour and the mortality is almost nil. On interfering with the composition of the food any nutritional deficiency expresses itself in retardation of growth and sometimes also in increased mortality. As the growing period is finished with the formation of the pupa the duration of the larval stage from the hatching of the larva from the egg until pupation constitutes the most significant figure for comparing the efficiencies of different diets.

Long ago it was pointed out that growth of Tribolium is much retarded on white flour. This is shown in the graphs of Fig. 1. On wholemeal flour pupation takes place after 25–28 days, and on a sample of highly milled patent flour (Burtonsbest, extraction about 40 per cent) 32–48 days. National straight run flour (extraction 73 per cent), the highest extraction permitted during the War for baking of white bread, on which pupation takes place after 29–32 days, shows a great improvement over patent flour, but is still markedly and significantly behind wholemeal flour in nutritional qualities. Addition of wheat germ to patent flour in increasing quantities results in the developmental period being progressively shortened until, with 2–4 per cent germ present in patent flour, its efficiency is about the same as that of wholemeal flour. In the wheat grain the germ constitutes about 2 per cent. Admixture of yeast (dried brewer's) to patent flour produces an even slightly more favourable effect than admixture of wheat germ. It therefore appears that if the external conditions are kept sufficiently constant small amounts of wheat germ admixed into a sample of highly milled flour can be assessed with a fair degree of accuracy by feeding the flour to Tribolium.

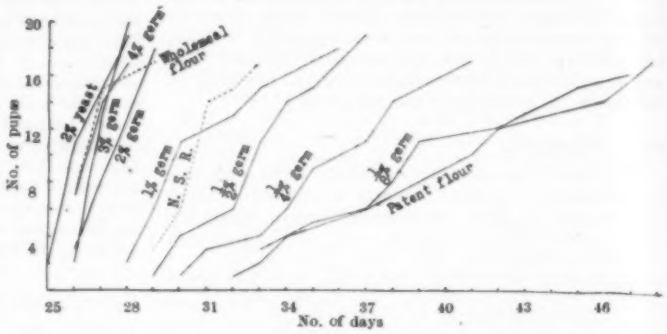


Fig. 1.

LARVAL GROWTH OF *Tribolium confusum* ON WHOLEMEAL FLOUR, NATIONAL STRAIGHT RUN FLOUR (N.S.R.), PATENT FLOUR AND ON PATENT FLOUR SUPPLEMENTED BY VARYING AMOUNTS OF WHEAT GERM OR BY YEAST.

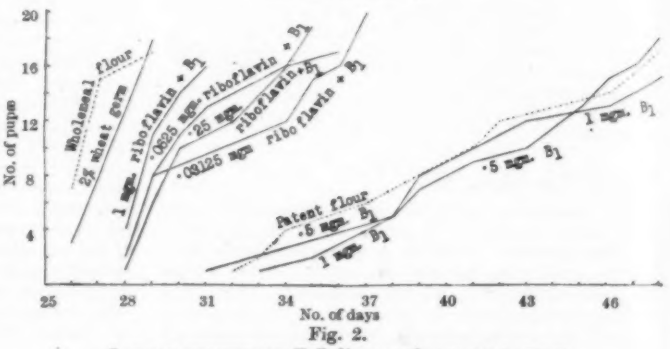


Fig. 2.

LARVAL GROWTH OF *Tribolium confusum* ON PATENT FLOUR SUPPLEMENTED BY VITAMIN B_1 AND RIBOFLAVIN. QUANTITIES PER 2 GM. OF FOOD.

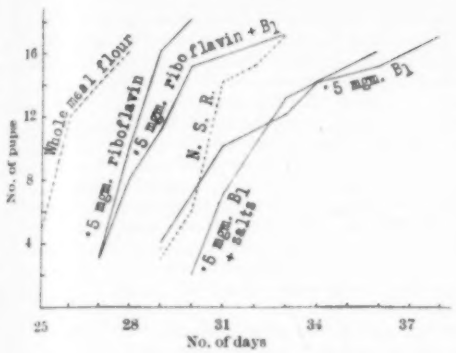


Fig. 3.

LARVAL GROWTH OF *Tribolium confusum* ON NATIONAL STRAIGHT RUN FLOUR (N.S.R.) AND ON N.S.R. SUPPLEMENTED BY VITAMIN B_1, RIBOFLAVIN AND SALTS. QUANTITIES PER 2 GM. OF FOOD.

Addition of pure vitamin B_1 (aneurin) to patent flour does not in the least alter its nutritional qualities; addition of riboflavin, however, to patent flour containing vitamin B_1 causes a very startling improvement (Fig. 2). We have found that very small quantities of riboflavin produce a marked effect (0·031 mgm. per 2 gm. of food). (Fröbrich (1939)[7] has shown Tribolium to grow well on food containing only 0·008 mgm. of riboflavin in 1·5 gm. of food. Larger quantities were found to be toxic, but we cannot confirm this.) The apparent differences in the efficiency of diets containing different quantities of riboflavin are possibly not significant and may be due to insufficient mixing. Riboflavin was mixed with patent flour in the dry state, and the series was obtained by dilution with more patent flour. It appears, therefore, that most of the deficiency of patent flour is remedied by addition of riboflavin. In this dilution series with riboflavin the diets also contained vitamin B_1 (0·5 mgm. per 2 gm. of food). Later experiments proved, however, that the same favourable effect is produced without adding B_1.

Similar experiments with National straight run flour (N.S.R.) led to the same kind of results (Fig. 3). Although the nutritional qualities of N.S.R. for Tribolium are not much inferior to those of wholemeal flour, addition of riboflavin to N.S.R. produced a marked improvement. Adding B_1 to N.S.R. alone or to N.S.R. plus riboflavin caused the diets to be slightly less efficient, which, however, might not be significant.

An attempt was also made to find out whether any deficiency of salts in patent flour and N.S.R. could be demonstrated. Addition of MacCollum's salt mixture in the proportion of 1 per cent to patent flour and to N.S.R., however, showed no significant effect (Fig. 3).

The results obtained with Tribolium fully agree with those recently reported by H. Chick[1] on the white rat. In both cases the nutritive value of N.S.R., even when supplemented with vitamin B_1 and salts, is markedly inferior to that of wholemeal flour. Chick's suggestion that this may be partly due to deficiency in riboflavin has been proved to be correct. Most of this deficiency is corrected by adding riboflavin. Moreover, the efficiency of patent flour and N.S.R. both supplemented with riboflavin is almost identical, and the efficiency of supplemented patent flour is apparently greater than that of unsupplemented N.S.R. (Figs. 2 and 3). This proves that the nutritional difference, demonstrable with Tribolium, between the two kinds of white flour of 40 and 73 per cent extraction is almost entirely due to lack of riboflavin in patent flour.

No practical conclusion can be drawn from the fact that Tribolium does not need more B_1 than is present in patent flour. Since the deficiency of white flour in B_1 is well known and the need of Tribolium for B_1 has been demonstrated, the amount of B_1 in patent flour seems to be well above the threshold of the requirements of Tribolium. On the other hand, if one considers the very low requirements of Tribolium for riboflavin and the startling improvement in the nutritional qualities of white flour after adding riboflavin, the deficiency of patent flour and even straight run flour in riboflavin must be regarded as being serious. Supplementing white flour with vitamin B_1 would, therefore, leave the deficiency in riboflavin unremedied.

We wish to thank Dr. J. D. Mountfield, of the Research Association of British Flour Millers, for supplying samples of National straight run flour, patent flour and wheat germ.

[1] Chick, H., *Lancet*, Oct. 26 (1940).
[2] Willcox, W., *Food*, **10**, 147 (1941).
[3] Chapman, R. N., *J. Gen. Physiol.*, **6**, 565 (1924).
[4] Sweetman, M. B., and Palmer, L. S., *J. Biol. Chem.*, **77**, 33 (1928).
[5] Nelson, J. W., and Parker, L. S., *J. Agric. Res.*, **50**, 894 (1935).
[6] Street, H. R., and Palmer, L. S., *Proc. Soc. Exp. Biol. N.Y.*, **32**, 1500 (1928).
[7] Fröbrich, G., *Z. vergl. Physiol.*, **27**, 335–383 (1939).
[8] Offhaus, K., *Z. vergl. Physiol.*, **27**, 384–428 (1939).

FATIGUE FOLLOWING HIGHLY SKILLED WORK*

BY PROF. F. C. BARTLETT, F.R.S.

IF the character and causation of fatigue following highly skilled work are to be understood, the first need is for the discovery of more relevant and experimentally controlled facts. Unfortunately, almost all the investigators who have attempted to study fatigue of this type have adopted methods taken over with very slight change from those which have proved valuable in the study of simple muscular fatigue. They have chosen elementary operations usually considered to require some 'mental' effort—such as easy calculations, word or colour recognition and naming and the like—have repeated these operations over and over again for long periods, and have tried to express the resulting fatigue in terms of the diminution in quantity or quality of the work done.

The skill fatigue of daily life is not set up under such conditions. Routine repetition of simple actions

* Substance of the Ferrier Lecture of the Royal Society, delivered on May 29.

is not characteristic of any highly skilled work, and least of all of work having a strong 'mental' component. The operations involved here are marked by complex, co-ordinated and accurately *timed* activities. The stimuli in response to which these activities are set up are neither simple nor do they usually fall into an order of fixed succession. They have the character of a field, or a pattern, which has become very highly organized, and may retain its identity in spite of a great diversity of internal arrangement.

It is possible to develop fully controlled experimental situations in which these realistic considerations have full play. When this is done, the picture of fatigue following highly skilled work which emerges has certain strongly marked characters.

In such fatigue the 'standards' accepted and followed by the central nervous system unwittingly deteriorate. The operator tends to think that he is doing better work, because errors treated as significant all the time get wider and wider limits. Until a stage of great fatigue is reached, it is far more likely that the right actions will be performed at the wrong times than that the wrong actions will be performed. If accurate timing is insisted upon, gross mistakes of action may appear. The stimulus field splits up. Its pattern character alters. It becomes a collection of unconnected signals for action, with some of these predominant over all the others. Particularly stimuli which are in the margin of the pattern, not closely organized with the central field, are ignored, 'forgotten', and serious lapses of specific reactions occur. There is a marked change in the effect of certain 'distracting', or additional stimuli. Sensations of bodily origin, in particular, become more pressing and insistent, and affect the performance in ways peculiar to the tired operator.

Side by side with all these changes go constant subjective symptoms. Verbal reports about any circumstances connected with known failure of performance become increasingly inaccurate, and errors are regularly projected upon objective conditions, or attributed to the interference of other people. There is a tremendous growth of irritability.

The light thrown by this picture upon the relation of high-level central nervous functions to simpler neuro-muscular mechanisms was discussed.

ROLE OF RADIATION MUTATIONS IN MANKIND*

By Dr. H. J. Muller

ACCEPTING, on the basis of work with organisms in general, including mice, the conclusion that X-rays and other high-energy radiations produce gene mutations in any human germ cells that are exposed to them, with a frequency exactly proportional to the dose of radiation used, we may ask: What are the conditions governing the manifestation of these mutations? When attention is confined to the recessive gene-mutations, which appear as the most pronounced and constant, yet insidious, genetic effects, it may be approximately calculated how long the latent period would be between the time of exposure of an individual who afterwards reproduces and the appearance of some descendant manifesting a recessive mutation that had been produced in one of the former's germ cells.

For the manifestation of a recessive gene two germ cells having the same allelically acting recessive genes must come together, forming a homozygote—an event that would happen with almost negligible frequency in the first-generation offspring, even from two irradiated parents. There are, however, two ways in which a homozygote manifesting the mutated gene could eventually be formed. One is by a germ cell containing it meeting in fertilization another germ cell which chances to contain an identical or allelic recessive gene which, having originated by some independent mutation, was already present in the population in some parallel line of descent. The chance of this event depends upon the frequency of such recessive mutated genes in the general population, and this can be calculated if we know the so-called 'spontaneous' mutation frequency, the rate at which individuals manifesting such genes are being eliminated in competition with normals, and the amount of inbreeding in the population. Sufficient data exist for calculating that under the condition of random breeding—which would give the highest frequency of such genes—very few recessive genes the manifestation of which would be of seriously detrimental character would exist in frequencies exceeding 1 in 30 or, more probably, 100 germ cells, in the general population. Thus it would on the average require some 30 or, more likely, 100 or more generations of breeding—some 750–3,000 years of human history—before the mutated gene would manifest itself by this process.

The other way in which the gene could manifest itself would be by a germ cell containing it meeting another containing a relative, so to speak, of the same gene, that is, an identical gene derived from the same ancestral mutated gene of the original treated individual. This requires the breeding together of more or less related individuals—'inbreeding'—and the chance of its occurrence depends on the total amount of inbreeding occurring in the population. In determining the frequency of this effect a special method of calculation has been employed, utilizing a simple proportionate relation of 1 to 4 which I have calculated to hold between the frequency of two related genes thus meeting each other and the frequency of two individuals having the same name by reason of some near or distant relationship marrying each other. Reckoning from known statistics on the latter events, it can be shown that, even in rural English communities, the chance of a mutated gene manifesting itself by this process is only about 1 in 200. That is, it would on the average take about 200 generations, or at least 5,000 years, for the gene to attain manifestation in such manner. Both causes operating together would not suffice to give a period of less than 600 years, and more probably one of thousands of years.

Of course these periods are only averages for the time of first manifestation; actually, the first manifestations of the different mutated genes would be

* Substance of a paper read at the annual meeting during April 28–29 of the U.S. National Academy of Sciences.

scattered rather evenly over the entire time from the generation after treatment until two or three times the length of the 'latent period' had elapsed It is to be noted, further, that this protracted 'latent period' does not mean that the mutated genes would tend, collectively, to become lost in the interim, since for each gene that died out by accident, in its 'covered' state, another would, on the average, increase in numbers, and so the final number of individuals first manifesting the mutations would fairly accurately represent the number of individuals produced in the first generation after treatment who had received the newly mutated genes. That is, the damage would be long postponed, but not prevented.

In so far as the individuals manifesting the abnormalities might themselves reproduce they would give them a chance to reappear repeatedly, until competition with the normals finally eliminated them. The recognition of these abnormals as having been produced by the original treatment would, however, be impossible, not only because of the long latent period but because they would appear merely as one relatively small part of the vast number of mutations that had occurred in the distant past, from all causes combined, and that had accumulated in the germ plasm. It can be shown that even if the mutation frequency of the population as a whole were doubled, in a given generation, by treatment of all of them with an average dose of, say, 300 r. the frequency of mutations that *manifested themselves* in the population would not be increased, in any one generation, by as much as 1 per cent of their own total, since the manifestation of the new additions to the store of mutations would be scattered over so many generations. If, however, the exposure that doubled the mutation frequency were to be continued generation after generation, the manifestation frequency would gradually rise and finally (after some hundred generations) attain the double value representing the double mutation frequency.

In these circumstances, the advisability of allowing the gonads of a person of reproductive or pre-reproductive age to be exposed to radiation must be decided by balancing the chance of benefit to him against the chance of detriment to future generations. Far more quantitative research is needed on this matter, but it will often be clear that the decision should be in favour of the exposure. Whenever possible, however, a person's gonads should be protected by a lead shield.

As for the question of the mutational effects of natural radiation, while this has been calculated to be of no consequence in flies, the 700-fold greater length of the human generation gives a chance for the accumulation of a sufficient dosage—some 10–15 r. —to have an appreciable effect in view of its also being continued generation after generation. More exact studies are therefore called for concerning the circumstances attending exposure of populations to unusually high amounts of such radiation, as well as of radiation of artificial origin.

SKIN EFFECT IN COMPOSITE AND FERRO-MAGNETIC WIRES

THE British Electrical and Allied Industries Research Association has published a report by G. G. Sutton on the high-frequency properties of wire specimens*. Novel results have been found in connexion with the effect of a longitudinal magnetic field on wires made of magnetic material. Ferro-magnetic wires are shown to have very high 'skin' factors, but the effective permeability determined from the experimental results is shown not to be constant but decreases to a small value as the frequency increases.

Earlier mathematical calculations have assumed a uniform known permeability, but it is known that with ferro-magnetic conductors the permeability varies with the magnetizing force, and hence it must vary over the cross-section of the conductor. It also varies with the current density and the temperature. In addition, hysteresis losses must be considered. Accordingly a mathematical solution is intrinsically very difficult, and it therefore seems necessary to have some direct means of measuring skin factor for magnetic and composite conductors.

The author describes two methods of doing this, both methods being based on thermal measurements. The first apparatus consists of two parallel brass tubes inside which were the specimen wire and a standard wire of eureka respectively. The heating effect of the current in the two wires was measured by observing the extensions by means of a travelling microscope. Both the eureka and iron wires were calibrated with direct current. A simple mathematical relation is then deduced to give the required skin factor. A more accurate method was afterwards developed, mercury being used at first as the indicating fluid, but it was abandoned as it was not sensitive enough. Finally, the liquid decided on was nitrobenzene as its physical properties were found most satisfactory.

The method of measurement developed for skin-factor measurements is shown to give consistent results with different types of specimen. The calculation of results in the case of ferro-magnetic materials is difficult, and in the case of composite materials it is very difficult. The author's method of measurement is direct and calculation is much simplified.

The method can be easily applied to the measurement of high-frequency currents. By further development it would be possible to eliminate many of the difficulties met with in this research. The effect of a longitudinal direct-current field on the high-frequency resistance of a mumetal specimen has been demonstrated; this is in accord with results already published on the arc impedance of specimens of mumetal wire at telephonic frequencies. From the results obtained in the case of ferro-magnetic materials, the effective permeability has been calculated; this tends to a small value as the frequency increases, as indicated by Arkadiew and others. Constructional diagrams are given for making the apparatus, and experimental diagrams are given showing the variation of skin factor with applied D.C. field in the case of a specimen of 26 S.W.G. mumetal wire.

* Technical Report, Reference M/T 69: The High Frequency Properties of various Forms of Wire Specimens. By G. G. Sutton. Pp. 19+13 plates. (London: British Electrical and Allied Industries Research Association, 1941.) 6s.

FORTHCOMING EVENTS

Monday, June 9

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Squadron-Leader P. J. A. Riddell: "Air Photography in War".

Tuesday, June 10

CHEMICAL ENGINEERING GROUP (SOCIETY OF CHEMICAL INDUSTRY) in conjunction with the INSTITUTION OF CHEMICAL ENGINEERS (Joint Meeting at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. G. H. Miles: "The Human Factor in Chemical Engineering Processes".

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 2.30 p.m.—Miss Audrey I. Richards: "Some Causes of a Revival of Tribalism in South African Native Reserves".

Wednesday, June 11

INSTITUTION OF GAS ENGINEERS (at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1), at 10 a.m.—78th Annual General Meeting; at 10.30 a.m.—Mr. George Dixon: Presidential Address.

ROYAL SOCIETY OF ARTS (at the Institution of Electrical Engineers, Savoy Place, London, W.C.2), at 2.30 p.m.—Mr. F. C. R. Douglas: "Economic Aspects of Soil Fertility and Nutrition".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

BOROUGH EDUCATION OFFICER—The Secretary, Education Offices, Stoke Road, Gosport, Hants. (June 10).

FARM SURVEY SUPERVISORY OFFICER, an ASSISTANT ADVISORY CHEMIST, a FIELD ASSISTANT (AGRICULTURAL CHEMISTRY), and a PERMANENT TECHNICAL ASSISTANT (AGRICULTURAL ECONOMICS)—The Registrar, The University, Manchester 13 (June 11).

HEAD OF THE COMMERCIAL DEPARTMENT—The Principal, Technical College, Park Square, Luton (June 14).

PROFESSOR OF ZOOLOGY—The Secretary, The University Edmund Street, Birmingham 1 (June 16).

ASSISTANT ENGINEER to the Middle Level Commissioners for Land Drainage Works—The Engineer, Middle Level Offices, March, Cambs. (June 16).

HEADMASTER—The Clerk to the Governors, Dulwich College, Dulwich, London, S.E.21 (June 21).

HEAD OF THE MECHANICAL ENGINEERING DEPARTMENT of the Salford Royal Technical College—The Director of Education, Education Office, Chapel Street, Salford 3, Lancs. (June 21).

SECRETARY OF THE WESTERN DISTRICT OF THE WORKERS' EDUCATIONAL ASSOCIATION—The Acting District Secretary, 9 Ashley Park, St. Andrew's, Bristol 6 (June 28).

ASSISTANT TO THE ENGINEER-IN-CHIEF—The General Manager and Secretary, Mersey Docks and Harbour Board, Dock Office, Liverpool (June 30).

HEADMASTER of the High School for Boys—The Secretary, King Edward's School, Edgbaston Park Road, Birmingham 15 (July 5).

HEADMISTRESS of the High School for Girls—The Secretary, King Edward's School, Edgbaston Park Road, Birmingham 15 (July 5).

TRAVELLING INSPECTORS OF DRYING PLANT for the Dehydration Branch of the Emergency Services Division of the Ministry of Food—Ministry of Labour and National Service, Central Register (Z.184), Queen Anne's Chambers, Westminster, London, S.W.1.

ASSISTANT IN THE MECHANICAL ENGINEERING DEPARTMENT—The Principal, Technical College, Wolverton, Bucks.

ELECTRICAL ENGINEER for the Public Works Department of the Nigerian Government—The Crown Agents for the Colonies, 4 Millbank, London, S.W.1 (quoting M/9422).

WARDEN—The Principal, Domestic Science College, Knighton Fields, Leicester.

WOMAN LECTURER TO ASSIST IN BIOLOGY AND GEOGRAPHY—The Principal, Edge Hill Training College, Bingley, Yorks.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Proceedings of the Royal Irish Academy. Vol. 46, Section A, No. 13: Analysis of the (0,3) Band of the First Negative System of the O_2^+ Molecule. By T. E. Nevin and T. Murphy. Pp. 169–182. 1s. Vol. 46, Section B, No. 10: A List of the Irish Species of *Tomaxis* and *Ephedrus* (Hymenoptera: Aphidiidae) with Descriptions of those which include Three Species New to Science. By A. W. Stelfox. Pp. 125–142. 1s. (Dublin: Hodges, Figgis and Co., Ltd.; London: Williams and Norgate, Ltd.) [133

Transactions of the Royal Society of Edinburgh. Vol. 60, Part 2, No. 13: Hormonal Analysis of the Cyclic Variations in the Vascular Architecture of the Uterus of the Guinea-Pig. By Dr. P. Bacsich and Dr. G. M. Wyburn. Pp. 465–474+1 plate. (Edinburgh and London: Oliver and Boyd.) 1s. 6d. [105

Ollsgoil na h-Éireann (The National University of Ireland). Calendar for the Year 1940. Pp. x+346+696+480. (Dublin: National University of Ireland.) [106

British Rubber Producers' Research Association. Publication No. 8: Analytical Methods in Rubber Chemistry, Part 1. By E. H. Farmer, G. R. Tristram and J. L. Bolland. Pp. 16. (London: British Rubber Producers' Research Association.) [106

University College of Wales, Aberystwyth: Welsh Plant Breeding Station. War Food Production, Advisory Bulletin No. 3: Herbage Seed Production. By Gwilym Evans. Pp. ii+30. (Aberystwyth: Welsh Plant Breeding Station.) 1s. [205

Report of the Marlborough College Natural History Society for the Year 1940. (No. 89.) Pp. 48+8 plates. (Marlborough: Marlborough College.) 3s.; to non-members, 5s. [205

Other Countries

Government of Iraq: Ministry of Defence: Meteorological Service. Annual Report of the Director, No. 4: Year ending 31st March 1940. Pp. 30. (Baghdad: Government Press.) [95

India Meteorological Department. Scientific Notes, Vol. 2, No. 90: Averages of Temperatures and Humidities in the Upper Air over Agra in the Polar Year 1932–33. By S. Basu, Ram Sahay and K. J. Kabraji. Pp. 77–84+6 plates. (Delhi: Manager of Publications.) 12 annas; 1s. [135

Cornell University: Agricultural Experiment Station. Bulletin 734: Use of Time in its Relation to Home Management. By Jean Warren. (Contribution from the Laboratories in Home Economics.) Pp. 98. Bulletin 736: Selective Factors in Migration from a New York Rural Community. By Amy A. Gessner. Pp. 56. Bulletin 737: Some Facts concerning Country Fruit and Vegetable Auctions in Eastern Seaboard States. By Edwin W. Cake. Pp. 52. Bulletin 738: Biology and Control of the Wheat Wireworm, *Agriotes Mancus* Say. By W. A. Rawlins. Pp. 30. Bulletin 740: Uninfected Elm Wood as a Source of the Bark Beetle (*Scolytus multistriatus* Marsham) carrying the Dutch Elm Disease Pathogen. By Donald L. Collins, K. G. Parker and Henry Dietrich. Pp. 14. Bulletin 741: The Business of Milk Retailing by Producer-Distributors in New York State. By Earl M. Hughes. Pp. 86. Bulletin 742: The Yellows Disease of Lettuce and Endive. By M. B. Linn. Pp. 33. Bulletin 744: Marketing New York Livestock. By W. M. Curtiss and E. H. Matzen. Pp. 36. Bulletin 745: Effects of Mineral-Nutrient Deficiencies and Excesses upon the Vegetative Growth and Flowering of Sweet Peas. By Kenneth Post. Pp. 28. Bulletin 746: Soil and Field-Crop Management for Southeastern New York. By A. F. Gustafson. Pp. 32. (Ithaca, N.Y.: Cornell University.) [145

The Rockefeller Foundation. A Review for 1940. By Raymond B. Fosdick. Pp. 64. (New York: Rockefeller Foundation.) [155

Records of the Geological Survey of India. Vol. 75, 1940, Professional Paper No. 9: The Cambrian Fauna of the Salt Range of India. By W. B. R. King. Pp. 16+5 plates. (Calcutta: Geological Survey of India.) 1.2 rupees; 1s. 9d. [155

The South African Journal of Science. Vol. 37: Being the Report of the South African Association for the Advancement of Science, 1940, Johannesburg. Pp. xxi+438. (Johannesburg: South African Association for the Advancement of Science.) 30s. net. [155

Ceylon. Part 4: Education, Science and Art (D). Administration Report of the Acting Director of Agriculture for 1939. By E. Roderigo. Pp. D34. (Colombo: Government Record Office.) 50 cents. [166

United States Department of Agriculture. Farmers' Bulletin No. 1863: The Turnip Aphid in the Southern States and Methods for its Control. By Norman Allen and P. K. Harrison. Pp. ii+10. 5 cents. Technical Bulletin No. 749: Composition of the American Gum Turpentine exclusive of the Pinenes. By T. C. Chadwick and S. Palkin. Pp. 16. 5 cents. (Washington, D.C.: Government Printing Office.) [165

Royal Observatory, Hong Kong. Magnetic Results, 1939. Prepared under the direction of C. W. Jeffries. Pp. 51+2 plates. (Hong Kong: Royal Observatory.) 1 dollar. [165

Records of the Geological Survey of India. Vol. 75, 1940, Professional Paper No. 7: Classification of the Gondwana System based on Vertebrate Faunal Evidence. By N. K. N. Aiyengar and M. S. Venkataram. Pp. 14. (Calcutta: Geological Survey of India.) 4 annas; 5d. [165

United States Department of the Interior: Geological Survey. Water-Supply Paper 847: Maximum Discharges at Stream-Measurement Stations, through December 31, 1937. By Gordon R. Williams and Lawrence C. Crawford. With a Supplement including Additions and Changes through September 30, 1938, by William S. Eisenlohr, Jr. Pp. iii+272. (Washington, D.C.: Government Printing Office.) 30 cents. [205